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Major household appliance service technician training needs of Iowa

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MAJOR HOUSEHOLD APPLIANCE SERVICE TECHNICIAN TRAINING NEEDS OF IOWA

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INTRODUCTION

Since the earliest settlement of immigrants on the eastern shore of what is now the United States, Americans have been striving to create an environment conducive to an easier and more enjoyable life. Basic to the progress made toward the fulfillment of this goal has been the free enterprise or capitalistic structure of the society. The competitive atmosphere, thus created, has led to many great advancements. As the needs for specific products have been discovered, competing firms have struggled to gain control of the market by introducing features not found on the competitors' products.

Ancillary to success in the competitive market place has been the field of research and development. This vital phase of industry has created a rapidly growing technology so vast and dynamic, it defies description. It is the application of this technology that has given the citizens of this nation the ease and comfort they enjoy today.

Progress is not made without difficulties, however. One of the major difficulties coincident with the application of technology has been that of maintenance. As new innovations have been introduced, greater complexity has been added. This increased complexity has resulted in the need for a more intelligent and better trained person to keep the product operational.

The household appliance field is no exception to the difficulties connected with repair and maintenance. For the above reason, this study is designed to investigate some of the various aspects of household appliance repair.

The Effects of Technology on the Workforce

The structure of the workforce is important to any study dealing with occupations. By investigating the nature of the labor force, it is possible to determine trends important to the specific occupation and to the economy as a whole.

The confrontation of the American economy with the dynamic growth of technology has resulted in an ever changing workforce. Earlier in this century the labor force could be conveniently classified into the categories of professional, skilled craftsman, and laborer. Today these terms are profoundly inadequate. For all practical purposes the occupations requiring only manual strength and dexterity have disappeared from the scene. Many manual jobs that do exist are being phased out with the advancement of automation and mechanization.

The degree to which manual labor occupations are being eliminated and the rapidity with which it is being done appears to be subject to local conditions. In 1965, Fuglsby (7) reported that for four northwest Iowa counties the indications were for an increase in demand for unskilled workers through 1970. He also pointed out that this was in opposition to the national trend.

The reduction of manual labor jobs has been accompanied by the growth of a new category in the structure of the labor force. This new category is

characterized by the term "Middle Manpower". Norman Harris defines it in the following way.

> "...'Middle Manpower' can be described as that portion of the total manpower spectrum which is concerned with jobs with a balanced cognitive-manipulative content. At one end of the middle manpower 'band' are jobs which are nearly professional in nature (e.g. science research technicians). At the other end are jobs closely related to the skilled trades (e.g. television service technicians). In general (but there are many exceptions), middle manpower occupations require post-high school education and training of one, two or three years, but for the most part a baccalaureate degree is not a requirement for entry into the job, nor for successful performance on the job." (9, p. 23)

From this definition, it may be inferred that there is no longer a neat and tidy cleavage between workforce categories. Instead middle manpower might be thought of as a continuum, with those nearly professional occupations on one end and the nearly skilled occupations on the other.

Another aspect of the labor force deserving consideration is that of worker age in relation to the growth of the workforce. U. S. Government figures show that the projected increase of the total labor force for the 1965-1975 decade will be about 20 percent (26). However, the portion of the labor force between the ages of 25 and 34 will have increased more than 40 percent. The growth in the younger age category when coupled with middle manpower trend will have important implications for education. These implications will be discussed later in this chapter.

A concurrent rise in family income has accompanied the structural changes of the labor force. The average family income in 1964 was $7,800.

The anticipated income per family is expected to be $10,400 by 1975 (13). This increase in income has outstripped the rise in the cost of living, thus making additional sums available for non-essential consumer goods and services. A portion of these extra funds has been utilized in the acquisition of added education. The advancements made toward more education have then in turn, increased income.

In summation, it may be said that technology has created changes in the structure of the workforce that have affected production, education and income. Current information indicates even greater changes may be expected in the future.

Technological Advancement in the Appliance Industry

The appliance field has felt the dynamic force of technology. From this technology have come advancements of great importance to the individual, and particularly the housewife.

Recent years have seen the development of the automatic washer, clothes dryer, dishwasher and other appliances at prices the majority of homemakers could afford. In order that they might take a greater share of the market, each manufacturer has striven to advance beyond his competitors in providing conveniences and features on his product not found on older models. The new features, however, have added greater complexity. The layman is no longer able to repair an appliance when it fails. This has created the need for

a technically-trained person familiar with the machine and capable of repairing it.

The effects of technology have not stopped at precluding repair by the owner, but have also made the skills and knowledge of many repairmen obsolete because they have failed to keep abreast with the changes. The advancement of the industry into the use of electronics and solid state controls has forced manufacturers to hold schools for appliance repairmen and to issue large volumes of instructions for each machine.

Technicians Not Repairmen

The introduction of "automatic defrost", "delicate cycle wash", "self cleaning" ovens and other innovations for the sake of convenience and ease, have antiquated many service practices. They have caused the unprogressive serviceman to fall by the wayside. He is now repairing obsolete machines in decreasing numbers.

The unprogressive service firm may be typified by the old store front building, badly in need of paint, an extremely small show room equipped with three or four less expensive models of the new line. The work shop area is cluttered with old parts, old machines and a broken down file cabinet. The personnel are generally nearing retirement age and express a nostalgic recollection of the time when the shop was full, and what a great device that old square tub machine was.

The repairman and the firm depicted above are the casualties of technology. They have served their usefulness and have served well, but have failed to advance with the industry. This repairman no longer has the knowledge and understanding necessary to effectively service modern machines.

The loss of servicemen due to technological advancement is felt both by the consumer and the appliance manufacturer. The consumer has difficulty in obtaining service and the manufacturer receives complaints about malfunctions that seemingly cannot be cured.

Forbes magazine quotes Ester Peterson, White House consumer advisor as saying:

> "The reputations of many fine corporations are suffering because repairmen give such bad service. When a repairman does a slipshod job, it's not only the consumer who gets hurt; the companies also get hit in the pocketbook." (20, p. 40)

Advertising Age reports that findings of the Consumer Research Center indicate that complaints to the manufacturer are likely to be due not to poor quality, faulty construction or premature failure, but from a lack of service (11). They further state that incompetency is a prime cause of inferior service.

Forbes explains that there are probably two major reasons why appliances break down. The first is that they do not receive the proper pre-consumer servicing. The second and more important to this paper is that servicemen don't know how to repair the machines. "...they're plain incompetent." (20, p. 42)

The reason for the incompetence lies in the type of individual required to handle the job.

> "Men with sufficient intelligence and education to learn how to fix an automatic defrost refrigerator with automatic ice-cube makers and with cooling ducts inside, like those of a centrally air-conditioned building, usually prefer to join an executive training program." (20, p. 42)

The use of electronics, solid state controls, etc., have elevated the competent serviceman above the position of a repairman. This is exemplified by comments from Ray M. Jeck, Assistant Service Manager for Amana Refrigeration, Inc.

> "...today the repairman must be a technician in the true sense of the word rather than a repairman... The individual must be of a personality that is geared for the understandings of mechanical, electrical, chemical and diplomatic interests."[1]

The problem is further complicated by the fact that the individual cannot stop at the point at which he is competent on one model of a certain make. He must be prepared to service all makes and all previous models.

Implications for Education

The changes in the manpower needs of the economy have necessitated changes in the education of the workers. A high school education, by itself, is becoming less and less commensurate to the requirements of employment.

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[1]Ray M. Jeck, Assistant Service Manager, Amana Refrigeration, Inc., Amana, Iowa. Information concerning skills. Private communication. April 19, 1968.

This fact has been recognized by the Federal and State governments. Funds have been made available for the purpose of conducting needs surveys as well as providing for greater educational opportunities beyond the high school.

In addition to increased requirements for post high school vocational education, another concern is the need for continuing education throughout the worklife of the individual. It is now estimated that an individual may need to be retrained as many as six or seven times between entry into the labor force and retirement (26). This implies a necessity for educational opportunity for both training and retraining the person.

The concept of "Middle Manpower" implies that the greatest emphasis for education should be above high school and below the baccalaureate degree. The primary concern in this area should not be manipulative education or cognitive education, but a balanced combination. The balance is seen as a means of building into the person the flexibility to adjust to change. Senator Wayne Morse, Chairman of the Education Subcommittee of the Senate Labor and Public Welfare Committee, stated,

> "It goes without saying that post-secondary vocational and technical institutions are in a position to play a major role in the future of our society. These institutions are in a unique position - a position in which they can train young people to enter the labor market and at the same time offer an education to prepare them to meet crises in their lives arising from the rapidly changing technology and expanding economy... The recent period of revolutionary discoveries and innovations in science and technology has resulted in such an accumulation of knowledge that even scientists and engineers are threatened with inability to keep up with their fields. If this problem is facing scientists and engineers, persons in the occupations ancillary

> to those fields are faced with an almost insurmountable task in keeping up. This means that post-secondary vocational and technical schools are going to have to adapt to continuing education programs in the technical fields. It means that education is going to become a facet of everybody's career which continues throughout an entire lifetime." (15, p. 5)

Another implication for education is brought to light by comments from Wayne E. Grimm, Director of the Chrysler Corporation Institute as quoted by Iron Age.

> "Schooling for skills is in trouble in our schools. It is outdated and obsolete in equipment and program... Despite its kinship to industry, vocational education has lagged farther and farther behind. Industry has not communicated its needs to educators." (10, p. 64)

This comment may be a greater indictment of education than it is of industry. It implies that industry is to blame, but shouldn't educators be certain of the validity of their programs before and while teaching or conducting them?

The Purpose of This Study

In making educational decisions, a sound foundation of knowledge is necessary. This study was intended to provide such a foundation in relation to the appliance service industry of Iowa.

Objectives

The objectives of this study were:

1. To determine the number of Iowa firms employing persons for the purpose of servicing and repairing major household appliances in communities of over 2,500 population.
2. To determine the additional needs of the identified firms employing service and repair specialists for major household appliances, both now and for three years in the future.
3. To determine the knowledge and skills which firms employing service and repair specialists for major household appliances desire their specialists to possess.
4. To determine if there is a need for part-time educational programs such as night school, for up-grading employed appliance service technicians.

Limitations

This study was a survey of the state of Iowa, designed in part, to determine if there was an actual or potential need for educational programs to train appliance service technicians. Therefore, it was limited to the geographic boundaries of the state of Iowa.

The study was further limited to the area of major household appliances. These appliances are defined as "white goods" by the appliance industry. No attempt was made to collect data concerning small electrical appliances or those appliances which are predominantly electronic in nature.

An effort was made to exclude the one-man, owner-operator type of repair firm. Firms from communities of less than 2,500 population were also excluded.

Definitions

The following definitions are presented to make possible a more complete understanding of the material contained within this study.

Appliance service technician - a person vested with the technical knowledge and skills necessary to service and repair modern major household appliances.

Appliance serviceman - a term used synonomously with appliance service technician except as otherwise noted.

Major household appliance - those household appliances generally categorized as "white goods" by the appliance industry, specifically room air conditioners, refrigerators and freezers, ranges, clothes washers, clothes dryers, and dishwashers.

Appliance service firms - those firms employing appliance service technicians for the maintenance and repair of major household appliances as defined above.

REVIEW OF LITERATURE

The National Picture

Information taken from the 1966-67 Occupational Outlook Handbook by the United States Department of Labor reveals an expected need of 90,000 appliance servicemen for the decade of 1965 to 1975 (27). The availability of these positions is attributable to an increased demand of 50,000 servicemen coupled with the need for 40,000 replacements. The growth is expected to result from a rapid rise in the use of household appliances. Factors seen as contributing to increased use of appliances include such things as introduction of new appliances, greater convenience afforded by new models, rising level of disposable income and increasing population. Employment opportunities in the appliance service field are not expected to increase proportionally with the rise in the use of appliances. Instead, advancements made by the appliance manufacturers in making the products more durable and efforts to make servicemen more efficient are viewed as factors resulting in a potential decline of the frequency of repairs per appliance.

If appliance usage is actually evidence of service need as was indicated by the Department of Labor, those appliances showing the greatest increase in usage should exhibit the greatest demand for service. Therefore, by studying appliance usage figures, it should be possible to ascertain the specific machines associated with the greatest demand for servicemen.

Statistical Abstract of the United States 1968 (24), published by the U. S. Department of Commerce designates the number of homes in the United States equipped with selected appliances. The figures provided by this source indicate a growth in the usage of all the appliances listed. The increase in number of homes equipped with the appliance was greatest for room air conditioners, when only major household appliances, as defined in chapter 1, were considered. The figures show 11.4 million homes equipped with room air conditioners in 1965, 17.6 million in 1967, and 22.0 million in 1968. This represents a 93 percent increase from 1965 to 1968.

However, it should be noted that these figures represent only homes that have at least one room air conditioner. There is no indication of the number of these homes containing more than one room air conditioner, nor an average number of air conditioners per home. Under these circumstances, it is not possible to determine the actual number of air conditioners in use.

Figures published in Steel (16) indicate the number of room air conditioners shipped from the factory for each year. For the years 1965, 1966, and 1967 factory shipments totaled 10.4 million units. Figures for 1968 are not yet available.

If a comparison was made between the Department of Commerce figures and the factory shipments, it would be noted that shipment of 10.4 million air conditioners from 1965 through 1967 would exceed the 6.4 million increase in homes containing room air conditioners. However, caution must be exercised

in making such a comparison. Consideration must be given to the fact that the Department of Commerce figures were drawn from information published each January and the shipment figures were published each March. Also to be considered is the fact that no information was given concerning the number of room air conditioning units shipped but left unsold at the time the figures were compiled.

Further investigation of Statistical Abstract of the United States (24) reveals that from 1965 to 1968, homes equipped with clothes dryers increased to 20.8 million from 13.7 million, or 52 percent. Homes having home freezers increased 24 percent going from 13.1 million to 16.3 million. Ranges were to be found in 28.2 million homes in 1968 as compared to 22.9 million in 1965. Clothes washers in homes showed an increase from 45.0 million to 56.6 million. Refrigerator equipped homes showed the smallest increase, eight percent, 55.5 million to 59.9 million during the same period.

Comparisons for each of the appliances in the preceding paragraph could be made in a manner similar to that used for air conditioners. To do so, however, would provide little insight into the problem of determining actual usage.

A more meaningful comparison might be made concerning the relative potential for increased appliance usage. According to Statistical Abstract of the United States (24), 60.1 million homes in the United States were wired for electricity on January 1, 1968. Of these 60.1 million homes, 99.7 percent had refrigerators, 94.3 percent had clothes washers, 47.0 percent had ranges, 36.7

percent had room air conditioning units, 34.6 percent had clothes dryers, and 27.2 percent had home freezers. These facts indicate considerable potential for increase in the use of ranges, room air conditioners, clothes dryers and freezers. There would appear to be a relatively small potential for increased usage for refrigerators and washers, except that due to population growth.

If any conclusion can be drawn from the foregoing information concerning the needs of appliance servicemen, it must be that there is greater potential for increased demand for repairmen of air conditioners, clothes dryers and home food freezers than for the other major appliances.

The Department of Labor, in the Occupational Outlook Handbook, views the training of appliance servicemen as predominantly on-the-job training (27). Six months to one year is expressed as the on-the-job time necessary for gas-appliance servicemen to become competent enough to work on their own. Electrical-appliance servicemen need up to three years to achieve this level of competence. Formal education in the form of vocational or technical schooling is indicated by the Department as a means of reducing the time spent in training.

According to the U. S. Department of Labor, the individual appliance serviceman is expected to possess mechanical aptitude, knowledge of science, physics, mathematics, electricity and electronics. This person must also display such characteristics as courtesy and tact, particularily in dealing with customers.

The Department of Labor states that "National earning data are not available for appliance servicemen." (27, p. 3). However, information from union-management contracts indicates an average salary for servicemen of from $1.65 to $3.85 per hour depending upon the type of firm and geographic location. This information does not include data on the multitude of small firms throughout the nation not under union contract.

A 1966 survey conducted by the Appliance Service News may reflect the conditions of the appliance service industry as a whole, more accurately than the government figures cited above. This survey, Appliance Service Labor Market Survey (1), reflects the opinions of 600 firms, selected at random from the 37,600 firms in the Appliance Service News circulation. They were drawn in direct proportion, by state, according to the percentage of the total circulation contributed by that state.

The purpose of the Appliance Service Labor Market Survey was to determine the accuracy of the opinion of the appliance service industry that there existed a shortage of appliance servicemen and that this shortage was increasing. Factors related to the cause of this shortage were, not enough educational facilities to train sufficient numbers of appliance servicemen, and the wages paid to the servicemen were insufficient to attract and hold the needed manpower.

The results indicated that 61 percent of the appliance service organizations were seeking to hire additional experienced servicemen. Most of the firms seeking servicemen wanted just one additional man. It was determined

that on a national average, each firm would hire 1.68 trained apprentices if they were available. Of the responding firms, 95 percent indicated a willingness to hire apprentices with training from trade and vocational schools or colleges. Fifty-three percent expressed a willingness to hire high school graduates with no vocational training. Only 18.5 percent responded favorably to the idea of employing apprentices with neither high school nor vocational training.

Over 57 percent of the firms expressed a willingness to hire inexperienced servicemen under the condition that part of the cost would be defrayed by the U. S. Department of Labor. Forty-four percent were favorably inclined to sponsor training schools with financial assistance from the government.

The rate of pay received by appliance servicemen was found to be dependent upon geographic location. The highest rates were found in areas of sparse population but concentrated population was not an indication of the existence of low rates. The national average for wages paid to appliance servicemen was computed to be $2.67 per hour. This amount was expressed as unfavorable by the survey when compared to the wages paid in other service industries.

> "A Grade A (an industry designation) auto mechanic earns about $3.75 per hour, a plumber $5.25, a house painter $4.40 and a brick layer $5.30." (1, p. 9)

The wages of radio-television repairmen were the only ones cited as less than those paid to appliance repairmen.

Another element affecting the occupation was that of prestige. It was concluded that the image of appliance servicing is poor and unattractive. This was seen as a factor of major importance concerning the causes of the personnel shortage.

The Local Situation

The condition of the appliance service labor market for the nation does not necessarily constitute a description of the conditions prevalent in any one state or locality. It is possible for adjacent states to exhibit extremely different characteristics in any phase of the labor market. It is even possible for differences to occur between communities.

With this idea in mind, several studies of labor market conditions were reviewed with the hope that from them a general picture of the appliance service labor supply, demand, and opportunities could be ascertained for Iowa.

A 1968 report, Occupational Opportunities in Nebraska (17), is included in this discussion because of the similarities between Iowa and Nebraska and the effects of the Nebraska labor market upon western Iowa.

The objective of the study, Occupational Opportunities in Nebraska, was to assess state-wide employment opportunities. A random sample from the 63,125 firms in Nebraska was drawn. This sample numbered 1,894 firms. Information obtained from these firms was used to project state-wide employment opportunities.

In the area of major household appliances, the Nebraska figures showed a 1968 employment of 3,824 persons in the categories of Air Conditioning (cooling), Appliance Repair, and Refrigeration. If it is assumed that the categories of Air Conditioning and Refrigeration refer to commercial equipment rather than household appliances, the figure reduces to 3,067. Because it is impossible

to determine from the study the exact intent of coverage for these categories, all three will be reported separately.

For the category of Air Conditioning (cooling), the projection for 12 months indicated a need of 167 employees due to turnover and expansion. The projection for three years indicated a need for 400 employees.

In the category of Appliance Repair, future needs were determined to be 900 in 12 months and 1,633 in three years. Figures concerning the need for personnel in the Refrigeration category indicated a need of 67 persons after 12 months and 100 after three years.

In all cases, the projected future needs were based upon returns of sample firms and projected by computer according to firm size and number of firms. Those firms in which no employees were hired, other than the owner, were excluded from the study.

In Iowa, from April, 1967, to January, 1968, at least four Skilled Needs Surveys (3, 14, 19, 22, and 23) were conducted by the Community Colleges for their respective Merged Areas. The merged areas represented were IX, X, XI, and XIII. The surveys from Area IX and Area XIII included data collected from firms in Illinois and Nebraska, respectively.

Combined data from all four of these surveys for the category of "Appliance Repairmen" were drawn from the responses of 22 firms, representing a total of 70 employees. The combined data also revealed a total of six vacancies for the four Merged Areas at the time the surveys were taken. The projected

need by 1970-71 for additional servicemen was listed at 46, of which Area XI contributed 42. Areas IX and X did not project figures into the future. Of the 22 firms responding, 17 indicated a shortage of trained personnel in the overall labor supply. Five firms described the labor supply as adequate.

These surveys were characterized by small numbers of respondents from the appliance service industry. One possible reason for such meager returns, as exemplified by only one respondent in Area XIII, might be the fact that with the exception of Area IX, all firms of less than four employees were excluded.

Langerman (12), in order to determine the demand for semi-skilled, skilled, and technical workers in central Iowa, surveyed all firms employing four or more people in Boone, Dallas, Guthrie, Jasper, Madison, Marion, Polk, Story, and Warren counties. In the electric appliance repairman category (small appliances), four vacancies were determined during January, 1967. In the category "Air Conditioning Mechanic, Domestic", one vacancy occurred in January, 1967. Eighty percent of the firms employing persons to service small electrical appliances indicated a shortage of trained personnel. However, 66.67 percent of the firms employing domestic air conditioning repairmen indicated a personnel shortage. Although neither of these two occupational categories fit neatly within the framework of the occupation being surveyed in this study, they are closely related and may provide an indication of the conditions prevailing in the appliance service industry as a whole.

The criticisms made concerning the Skilled Needs Surveys conducted by the Community Colleges apply also to the Langerman study. It is characterized by very few responses from the appliance service firms.

Educational Requirements for Appliance Service Technician Training Programs

The preceding sections of this chapter have dealt with the need for Appliance Service Technicians, which is an extremely important consideration in determining the advisability of establishing training programs. If it is ascertained that a shortage actually exists and the decision is made to start a training program, consideration must then be given to the knowledge and skills to be taught. These are best determined by contact with those people within the occupation. However, it is possible to gain insight into the necessary occupational skills and knowledge by studying existing courses of study.

A cursory examination of several courses of study soon leads one to realize that differences in content and emphasis are present in various educational programs. These differences are partially due to specific educational and occupational goals of the particular programs. The goals of separate programs may differ even though the title and main objective appear to be identical.

Table 1 itemizes the classroom hours devoted to 16 categories of appliance service training by courses of study of seven appliance service training programs. The categories listed are not necessarily mutually exclusive for

Table 1. Hours of instruction devoted to specific course content by seven courses of study

Course content category	Courses of study						
	A	B	C	D	E	F	G
1. Communications skills	50						
2. Business principles and practices	100						
3. Warranties, service policies, etc.	20						
4. Customer and job relations	80			110		24	3
5. Merchandising and warehousing	20						
6. Mathematics	100	100	75		10	120	
7. Basic electricity	180	140	130	40	60	175	6
8. Basic chemistry, physics, thermodynamics	160						
9. Mechanisms and controls	80			65	209		9
10. Mechanical operation and servicing	770	550	385	572	276		
11. Refrigeration principles		750	674	25	45	600	
12. Heating devices				10		456	
13. Motor driven appliances				10		60	
14. Miscellaneous				8	5	5	
15. Small appliances			50				
Total instructional hours	1560	1540	1314	840	605	1440	18

Course of Study Identification

A - Appliance Service Technology Programs (21)
B - Electrical Appliance Servicing (5)
C - Electric Appliance Servicing (4)
D - Electrical Appliance Serviceman (25)
E - Proposed Appliance Repair Course (18)
F - Refrigeration, Heating and Major Appliance (28)
G - Appliance Service (upgrading skills) (2)

each course of study. Each course of study is divided into component categories. However, they do not all use the same terminology nor identical categorical limits. For this reason, the hours listed as being devoted to any particular category may include some time that would more properly be defined by some other category or categories. For example, the category of Refrigeration Principles lists 600 hours for Refrigeration, Heating and Major Appliance (28). It would not be unreasonable for this time allotment to include some time more properly defined by Mechanical Operation and Servicing.

The purpose of Table 1 is to facilitate the identification of areas or categories of general emphasis, not for the comparison of programs. To compare these seven training programs on the basis of hours of instruction devoted to a specific category would be to negate the individuality of each program. It would negate the idea that each program should be based upon specific identified needs for the geographic locality which the program is to serve.

The selection of categories for inclusion in Table 1 was made through examination of the various courses of study. Categories one through ten were selected from the Appliance Service Technology Programs (21) for their generality and inclusiveness. Justification for their inclusion is given in the rationale of the Appliance Service Technology Program.

> "The rationale in the design...was that a trainee in such a program should: (1) be literate in his communications with the public that he is to serve and would have adequate skills to effectively follow directions and communicate these directions

> to his superordinates, peers, and subordinates; (2) be exposed to and become sufficiently proficient with the basic principles of business procedures and practices; (3) be familiar with warranties, service policies, etc. of the manufacturer on the product that he services and sells; (4) have an understanding of basic merchandising and warehousing techniques; (5) be aware of some of the basic principles of customer relations and relationships with other associates within a service organization; (6) be sufficiently proficient in the manipulative skills of mathematics to perform the normal business and service function of his organization or position; (7) be aware of the basic principles of electricity and have a basic skill to work with the electrical aspects of appliance installation and repair; (8) have a fundamental understanding of how and why an appliance performs the function for which it was designed through the basic laws of physics, chemistry, and the actions of basic mechanical and electrical mechanisms; and (9) have a proficiency developed in the installation, problem diagnosis and repair of major and small appliances in homes and business enterprises. As a result, the following ten broad subject areas were considered to be the most necessary for the training of an appliance service technician..." (21, p. 3-4)

The other categories were selected from the various courses of study because they contained blocks of time that could not be conveniently classified into any of the first ten categories.

Examination of Table 1, page 22, reveals that categories ten and 11 contribute the largest blocks of time. Category ten, mechanical operation and servicing, would be expected to represent the substance of a course in major appliance servicing. The large contribution of category 11, refrigeration principles, would appear to reflect the amount of emphasis on refrigeration in the respective courses. The evidence available from Table 1 indicates that three of the seven courses of study emphasize refrigeration in their appliance service training programs.

Basic electricity (category seven) and mathematics (category six) are given relatively large amounts of time by nearly all courses of study. This indicates the importance of these two areas as basics to the appliance service field. The only exception to the inclusion of mathematics in the course of study was by course of study G (2), which represents a course designed to upgrade skills.

In the realm of related information, only customer and job relations show inclusion by more than two courses of study.

Basic chemistry, physics and thermodynamics commands inclusion as a block from only one course of study.

The conclusion to be drawn from the information in Table 1 would be that mechanical operation and servicing, refrigeration principles, basic electricity, mathematics, mechanisms and controls, and customer and job relations represent the categories into which the largest amounts of instruction time fall. It should be again cautioned that these categories are not mutually exclusive and therefore care must be taken in their interpretation.

Summary

The indications are that for the period of 1965 to 1975, a need for 90,000 appliance servicemen will develop. This need is viewed as a result of increased appliance usage. It is expected that appliance servicemen will become

more proficient and appliances more durable, but customer demand for appliances will outstrip these gains.

Room air conditioners show larger sales and greater potential for sales than any other appliances. Clothes dryers and home food freezers also show great potential in the sales market of the future. If appliance usage and potential usage can be used as a measure for determining appliance service need, these three appliances demand consideration when preparing men for the appliance service field.

In 1965, it was the opinion of the appliance service industry that servicemen were in short supply. The Appliance Service News undertook the task of determining the accuracy of this opinion. Their survey (1) determined that six out of ten appliance service organizations were seeking to hire additional servicemen. It was also ascertained that appliance servicemen were receiving pay less than that received by other service trades.

For the state of Iowa, the evidence concerning the need for appliance servicemen is rather inconclusive. No actual need has been shown for the state as a whole, but skilled needs surveys of the state have provided inadequate information.

Examination of courses of study of appliance service training programs shows that much time is devoted to such items as mechanical operation and servicing, refrigeration principles, mathematics, mechanisms and controls, and basic electricity. Little emphasis is given to such items as communication skills, business principles and practices, warranties and merchandising.

PROCEDURES

The primary purposes of this survey were to determine the number of Iowa firms employing appliance service technicians and to ascertain if a shortage of appliance service technicians exists in Iowa. Secondary goals were to determine the knowledge and skills needed by appliance service technicians and to secure from the employers of appliance service technicians information concerning the need for part-time training programs for technicians in their employ.

This chapter describes the procedures used in the collection and analysis of the information necessary to fulfill the objectives of the study.

Population

The population surveyed for this study included firms rendering repair service on major household appliances. The initial listing was compiled by the Vocational Education Branch, Iowa Department of Public Instruction, under the direction of Dr. Kenneth Wold. This listing contained the names and addresses of firms advertising appliance repair and service in the advertising section of the several telephone directories of Iowa. The initial list was drawn from the cities and towns of Iowa with a population of 3,000 or more.

The list furnished by the Vocational Education Branch was expanded to include those firms located in the towns of 2,500 to 3,000 population. The decision to expand the original listing was based upon the fact that certain portions of the state had relatively few towns of more than 3,000 population. It was

decided that lowering the population limit to 2,500 would give adequate representation to some of these sparsely populated areas. It was felt that to lower the population limits beyond this level would be of negible value in that few firms in a community this small would employ appliance service technicians.

By limiting the survey to those firms which employ appliance service technicians, the one-man, owner-operator type of establishment was eliminated. There is no doubt that these firms and their individual owners could provide information concerning the needed skills and knowledge for success in the occupation. The decision to exclude these firms was based upon the opinion of persons in the Vocational Education Branch, Iowa Department of Public Instruction, that a survey of one-man operations would produce little in the aspect of determining manpower and part-time training program needs. It was also determined to be both expensive and time consuming to develop a mailing list of these firms as most of them do not advertise in the telephone directory. Personal interviews and conversations with owners and managers of appliance service firms revealed no organization common to all phases of appliance servicing from which a mailing list might be obtained.

Instrument

The use of a questionnaire was determined to be the most economical method of gathering data from such a large geographical area. The questionnaire was designed so that one form could provide all of the needed data.

The employers were asked to furnish information concerning the number of appliance service technicians employed or expected to be employed for the years 1967 through 1971. They were also asked to report actual and anticipated replacements of appliance service technicians from 1968 to 1971. The number of appliance service technician vacancies occurring at the time the questionnaire was received was queried. It was hoped that the answers to the foregoing questions would provide insight to the demand and turnover of appliance service technicians.

Questions related to the source of training for currently employed appliance service technicians were asked to determine the major source of trained technicians. Each firm was asked how many appliance service technicians presently employed would benefit from part-time instructional programs, how many would be encouraged to attend, and how many the respondent thought would attend if the programs were available. These questions represented an attempt to determine the need for such part-time programs in the Area Schools and Community Colleges of the state.

Additional questions were asked to provide a more complete depiction of the nature of the work force in question. Other questions were used to ascertain if any particular appliances represented a major portion of the work load required of the appliance service technician work force.

In an attempt to define the qualifications needed by an appliance service technician, employers were asked to respond to 79 items of knowledge and skill

on a five point rating scale. The major groupings of items were mathematics, English, business practices, general electrical information, basic direct current, alternating current, chemistry, physics, thermodynamics, theory and structure of appliance mechanisms, theory and operation of appliance controls, instruments, and operations or skills. Twelve of these 13 categories were subdivided into from two to 11 more specific items.

The questionnaire was designed from information obtained from various appliance service training programs and their course of study. It was then tested by interviewing the owner or manager of ten firms randomly selected from the central Iowa area.

A copy of the questionnaire is included in Appendix A.

Collection of Data

Because of the large number of firms and their diverse locations throughout the state of Iowa, it was decided to mail the questionnaire. A cover letter signifying the importance of the information to the study and indirectly to the employer himself was attached to the questionnaire.

Two weeks after the first mailing, a follow-up card was sent to each non-responding firm. Two weeks later, a follow-up letter and an additional questionnaire were mailed to those firms failing to return the first questionnaire.

Four weeks after the mailing of the second questionnaire, it was decided to contact those non-responding firms of the metropolitan areas either by

telephone or personal interview. It was decided that to attempt to telephone or interview all non-responding firms would be too expensive where they were not closely grouped, geographically. Interview trips were made to Sioux City, Des Moines, Waterloo, Cedar Falls, Cedar Rapids, Osceola, Creston and the surrounding areas.

The reminder card and follow-up letter are included in Appendix B.

Analysis of the Data

The questionnaires were examined as they were received to determine their applicability to the study. The information from those firms to which the study did apply was then recorded on 80-column IBM business machine cards.

Arithmetic frequencies and totals were tabulated for all of the possible responses to the questions concerned with the number of appliance service technicians employed, their education, their need for up-grading, ages, wages, availability, appliances serviced, etc.

Arithmetic frequencies and means were figured for each item answered by a response on the rating scale. The means were figured by assigning to the rating scale a value of five for the category essential, four to the category highly desirable, three to desirable, two to background knowledge only, and one to very little importance. The resulting means therefore are represented by a number from one to five indicating the relative importance of each item as it was viewed by the appliance service industry of Iowa.

FINDINGS

The purpose of this study was to obtain information concerning the major household appliance service industry in the state of Iowa. In order to satisfy the specific objectives of the study, the data are reported in four sections. These sections are: (1) information about the respondents, (2) information about major household appliance service technicians, (3) information concerning the need for part-time educational programs, and (4) information concerning the knowledge and skills needed by major household appliance service technicians.

Findings Related to Respondents

General information

Useable questionnaires were returned from 181 firms, each of which was located within or near a specific merged area. The firms located within a community that was not a part of a merged area were arbitrarily assigned to the nearest merged area.

Useable questionnaires were also returned from three firms whose operations crossed merged area boundaries. One of these questionnaires was completed by a distributor of appliances and appliance repair parts. The information contained in this questionnaire was compiled from the Iowa repair firms serviced by the distributor. The other two questionnaires which contained information relative to more than one merged area were returned by utility companies.

To insure that the confidence of these three firms would not be violated, they were assigned the term multi-area firms so that they would not have to be identified by name. When these firms were referred to separately, they were identified by the terms distributor, utility A, and utility B.

There were 106 firms to which the questionnaire was mailed but not returned. There were 188 firms on the mailing list to which it was determined that the study did not apply.

Information was obtained, directly or indirectly, from a total of 258 individual appliance service firms. The number of appliance service centers represented by these 258 firms exceeded 271. The exact number of service centers was not available for utility B.

The limitations set forth previously were met by 181 of the responding firms. The multi-area firms reported data that could not be included within these limitations. Therefore, they are reported separately where the data are applicable.

Table 2 illustrates the distribution of the 181 individual firms by merged area.

The three firms which provided information relative to more than one merged area are excluded from Table 2. Future reference to these firms will describe them as multi-area firms.

Table 2. Distribution of responding firms by merged area

Merged area	Number of firms
I	6
II	8
III	5
IV	7
V	19
VI	3
VII	16
VIII[a]	6
IX	7
X	19
XI	36
XII	15
XIII	10
XIV	9
XV	9
XVI	6
Total	181

[a]Iowa Merged Area VIII has been proposed by the State Department of Public Instruction, but it has not been organized into a functioning educational unit.

Information concerning the size of firms

Of the 181 firms reporting from the merged areas, 72.4 percent hired fewer than three major household appliance service technicians each. Fewer than five technicians were hired by 92.8 percent of the firms. The complete distribution of firms by size and merged area is given in Table 3.

Table 3. Distribution of responding firms by firm size and merged area

Iowa Merged Area	Number of appliance service technicians employed					
	1-2	3-4	5-6	7-8	9-10	Over 10
I	6					
II	7	1				
III	4	1				
IV	6	1				
V	15	4				
VI	3					
VII	10	5				1
VIII	5			1		
IX	4	2		1		
X	11	5	1			2
XI	24	8	1	2		1
XII	10	4			1	
XIII	8	2				
XIV	7	1	1			
XV	6	3				
XVI	5	–	1	–	–	–
Total	131	37	4	4	1	4
Percent	72.4%	20.4%	2.2%	2.2%	.6%	2.2%

It should be noted that firm size is determined by the number of major household appliance service technicians employed rather than by the total number of employees.

All three of the multi-area firms were in the "over 10 technicians" category of firm size, but were not included in Table 3.

Information concerning types of appliances serviced

In an attempt to determine if service for any particular appliance was not available within the state, the firms were asked to indicate which of the appliances they actually serviced. The responses were recorded in Table 4.

The categories of "gas room air conditioner" and "gas refrigerator and freezer" drew the fewest responses. These two categories drew responses from 32 and 40 percent of the firms, respectively. The responses drawn by each of the other appliance categories ranged from 70 to 86 percent of the total number of responding firms. The categories receiving the most responses were those of "electric clothes washer" and "electric clothes dryer." These categories each drew responses from 82 percent of the firms.

Inspection of Table 4 reveals that the firms offering service for the electric model of an appliance are more numerous than those offering service on the gas counterpart of the same appliance.

All merged areas received responses indicating that service was available for all of the appliances under consideration except Area II. Merged Area

Table 4. Number of firms reporting service on each appliance

	Gas room air conditioner	Gas range	Gas refrigerator freezer	Gas clothes dryer
Iowa merged area				
I	1	2	1	5
II	0	6	0	6
III	3	4	2	4
IV	1	6	1	7
V	5	12	8	12
VI	2	3	2	3
VII	1	11	3	12
VIII	1	4	1	4
IX	2	4	2	6
X	7	16	10	14
XI	14	29	20	31
XII	8	11	9	13
XIII	5	5	5	7
XIV	4	7	6	8
XV	2	6	1	7
XVI	1	2	1	4
Total	57	128	72	143
Firm size				
1-2 technicians	37	91	45	100
3-4 technicians	13	26	18	32
5-6 technicians	1	2	3	2
7-8 technicians	3	4	1	4
9-10 technicians	1	1	1	1
over 10 technicians	2	4	4	4
Total	57	128	72	143
Percent of all firms	31.5	70.2	39.8	79.0

Electric room air conditioner	Electric range	Electric clothes washer	Electric refrigerator freezer	Electric clothes dryer	Electric dishwasher
5	4	6	6	6	5
7	7	6	8	7	7
4	4	4	4	4	3
4	5	6	3	6	6
18	15	16	17	15	15
2	2	2	2	2	2
11	12	12	12	12	12
3	6	6	3	6	6
6	5	6	5	5	4
18	18	19	18	19	18
31	32	33	30	33	31
12	11	12	11	12	12
10	8	7	9	7	7
7	8	8	8	8	8
8	8	7	9	8	7
5	5	6	5	6	6
151	150	156	150	156	149
106	104	110	104	110	105
34	32	33	33	34	31
4	4	4	4	2	4
2	5	4	4	5	4
1	0	1	1	1	1
4	4	4	4	4	4
151	150	156	150	156	149
83.4	82.9	86.2	82.9	86.2	82.3

II had no reported service available for "gas room air conditioner" or "gas refrigerator and freezer".

Information concerning the frequency of service for specific major household appliances

Table 5 categorizes the responses of the employing firms to questions relating to the frequency of service for each major household appliance.

The number of firms providing service for each of the appliances listed was relatively uniform. Clothes dryers were reported to be serviced by 158 firms. Dishwashers were reported to be serviced by 149 firms. The other

Table 5. Frequency of servicing specific appliances

Firms reporting each appliance as being	Room air conditioner	Range	Clothes washer	Refrigerator and freezer	Clothes dryer	Dishwasher
1. serviced	151	152	156	154	158	149
2. the one most frequently serviced	18	6	106	43	21	2
3. the one least frequently serviced	24	35	11	32	19	43

Note: When totaled horizontally, the sum of the responses may total more than the total number of reporting firms because some firms reported more than one appliance for a specific item.

appliances were reported to be serviced by firms numbering between these two figures.

The appliance that was reported to be the one serviced most frequently by the greatest number of firms was the clothes washer. The clothes washer was reported by 106 firms. The appliance reported to be the most frequently serviced by the fewest number of firms was the dishwasher. The dishwasher was reported by two firms.

The appliance reported to be least frequently serviced by the greatest number of firms was the dishwasher. Forty-three firms responded in this manner. Eleven firms reported the clothes washer as the appliance least often serviced.

Information concerning the employment needs of firms employing appliance service technicians

From Table 6 it may be determined that "refrigerator and freezer" represents the category of appliances for which the greatest number of appliance service firms felt it was the most difficult to hire a technician.

Twenty-seven firms reported employing a specialist to repair refrigerators and freezers. Fifteen firms reported employing a specialist for clothes washers and 12 reported employing a specialist for clothes dryers.

Sixty-one firms, approximately one-third of the firms responding to the questionnaire, reported that they would like to hire a specialist to work on refrigerators and freezers, if it were possible for them to hire such an

Table 6. Employment needs of firms employing appliance service technicians

Firms reporting each appliance as being the one for which	Room air conditioner	Range	Clothes washer	Refrigerator and freezer	Clothes dryer	Dishwasher
1. it is the most difficult to hire technicians	17	3	16	78	4	2
2. a specialist is hired	8	5	15	27	12	0
3. it would be desirable to hire a specialist, if it were possible to hire such an individual	12	0	28	61	11	1

individual. Twenty-eight firms indicated that they would like to hire a specialist for the clothes washer.

When asked if they would hire a specialist if one were available, a nearly even split between "yes" and "no" responses resulted. Seventy-seven firms responded that they would hire a specialist, while 75 responded negatively. Two firms responded with the word "possibly". Twenty-seven firms failed to respond.

Firms in Merged Area XI provided a somewhat unique pattern of responses to the "hiring of a specialist" item. In most of the areas, the distribution

of the "yes" responses on one hand, and either a "no" or a "failure to respond" on the other, resulted in a nearly equal split. However, in the case of Area XI, 27 of the 36 responding firms replied "no" or did not respond at all. Only seven firms responded affirmatively. Two firms responded with the word "possibly".

When asked if they had experienced difficulty in hiring qualified appliance service technicians, 85 percent of the responding firms replied affirmatively. The reason most often given for this difficulty was that the applicants for the job lacked the necessary qualifications. The number of firms responding in this manner was 76. Twenty firms listed the reason for the shortage as being a lack of applicants for the position. Fifty firms listed both of the foregoing reasons.

Other reasons given as causes for the difficulty experienced in hiring qualified major household appliance service technicians included low pay, long hours, hard work, lack of experience on the job, competition for applicants by manufacturing and governmental establishments, poor attitude by applicants toward customer, dishonesty and too many government handouts.

The three multi-area firms all replied that applicants lacked the necessary qualifications.

Findings Related to Major Household Appliance Service Technicians

Employment information

For the year 1967, the merged area firms reported employing a total of 431 major household appliance service technicians, as recorded in Table 7.

Table 7. Present and projected employment of appliance service technicians

	Number of technicians 1967	Number of technicians 1968	Change 1967-1968	Projected number of technicians 1969	Projected number of technicians 1970	Projected number of technicians 1971	Change 1969-1971	Number of vacancies 1968[a]
Firm size								
1-2 technicians	178	180	+ 2	189	190	191	+ 2	38
3-4 technicians	111	120	+ 9	119	113	117	- 2	26
5-6 technicians	17	20	+ 3	21	24	24	+ 3	3
7-8 technicians	28	32	+ 4	34	37	39	+ 5	0
9-10 technicians	8	10	+ 2	12	14	16	+ 4	0
over 10 technicians	89	98	+ 9	104	111	117	+13	3
Total firm sizes	431	460	+29	479	489	504	+25	70
Iowa merged areas								
I	9	9	0	7	8	6	- 1	2
II	11	15	+ 4	13	15	15	+ 2	1
III	9	9	0	12	12	13	+ 1	1
IV	11	10	- 1	11	15	12	+ 1	2
V	33	33	0	35	37	39	+ 4	8
VI	4	5	+ 1	7	8	10	+ 3	2

[a]Number of vacancies date questionnaire was received.

Table 7. (Continued)

	Number of technicians 1967	Number of technicians 1968	Change 1967-1968	Projected number of technicians 1969	Projected number of technicians 1970	Projected number of technicians 1971	Change 1969-1971	Number of vacancies 1968[a]
VII	36	40	+ 4	42	41	43	+ 1	6
VIII	15	16	+ 1	18	19	21	+ 3	1
IX	16	19	+ 3	21	23	24	+ 3	1
X	95	102	+ 7	108	111	116	+ 8	9
XI	99	102	+ 3	104	96	101	- 3	19
XII	33	32	- 1	32	34	36	+ 4	7
XIII	18	16	- 2	22	22	22	0	3
XIV	17	21	+ 4	18	20	17	- 1	4
XV	15	19	+ 4	16	15	16	0	3
XVI	10	12	+ 2	13	13	13	0	1
Total merged areas	431	460	+29	479	489	504	+25	70
Multi-area firms								
Distributor	-	91	-	100	125	150	+50	10
Utility A	24	24	0	28	30	32	+ 4	0
Utility B	133	144	+11	153	162	171	+18	5
Total multi-area	157	259	+11	281	317	353	+72	15
Total all firms	588	719	+40	760	806	857	+97	85

The multi-area firms reported an employment level of 157 technicians. The distributor failed to respond to this item. The data therefore reflect the conditions of employment of 183 firms.

In 1968 a total of 719 appliance service technicians were employed by 258 firms. Of these, 460 were employed by the 181 firms classified within the merged areas. The increase from 1967 to 1968 was 29 in the merged areas and 11 for the multi-area firms, thus giving a total increase of 40. In percents, the increase for the merged area firms was 6.7 percent, for the multi-area firms it was 7.0 percent, and for the total of all firms, the increase was 6.8 percent.

Projected employment figures for the years 1969 through 1971 do not indicate a continuation of this rate of growth. The anticipated rate of increase in employment level for the merged area firms was computed to be 5.2 percent. The anticipated rate of increase for the multi-area firms was computed at 25.6 percent. The percent of anticipated growth for all firms was 12.8 percent. The total number of additional appliance service technicians anticipated to be needed due to expansion during this period was reported to be 97. Only 25 of these were reported by the merged area firms.

The number of vacancies open to major household appliance service technicians, at the time the questionnaire was received by the respondents, totaled 85. Seventy of these vacancies were reported to be in the merged area firms. In other words, firms employing 64 percent of the appliance service technicians listed 82.3 percent of the vacancies for technicians.

A complete distribution of the employment levels for the years 1967 through 1971, the amount of change in employment levels, and the number of vacancies is given in Table 7. Information is given relative to firm size, merged area, and multi-area firm.

It should be noted that the projected employment figures for 1969 through 1971 represent responses from fewer and fewer firms as the dates progress into the future. Two firms failed to report the employment information for 1968. Twenty-one firms failed to project to 1969, and 39 failed to project to 1971. Twenty-four firms failed to report the number of vacancies.

It cannot be assumed that all of the vacancies reported in Table 7 are due to expansion. Loss of technicians due to retirement and other reasons may have contributed to this vacancy list. Data concerning the specific reasons for each vacancy were not obtained. However, an indication of the turnover in appliance service technicians is given in Table 8. The distribution of replacements and anticipated replacements of appliance service technicians by merged area, firm size and multi-area firm is illustrated in Table 8. Reported replacements for the year June, 1967, to June, 1968, were 69. Twenty-two of the 183 firms failed to respond to this question. It cannot be assumed that these non-responding firms did not have replacements during this period.

The projected replacement figures appear to be low when compared to the actual replacements from 1967 to 1968. However, as with the case of projected employment levels, as the projection reached further into the future, fewer firms were willing to respond.

Table 8. Replacements and projected replacements of appliance service technicians

	Replacements 1967-1968	Projected replacements 1968-1969	Projected replacements 1969-1970	Projected replacements 1970-1971	Total projected replacements	Total number firms
Firm size						
1-2 technicians	27	16	10	14	40	131
3-4 technicians	14	8	9	10	27	37
5-6 technicians	3	1	0	0	1	4
7-8 technicians	6	1	1	1	3	4
9-10 technicians	1	0	0	0	0	1
over 10 technicians	8	5	3	4	12	4
Total	59	31	23	29	83	181
Iowa merged area						
I	0	0	0	0	0	6
II	3	1	1	2	4	8
III	2	0	0	1	1	5
IV	2	2	1	2	5	7
V	9	7	8	8	23	19
VI	0	0	0	0	0	3
VII	3	2	1	0	3	16
VIII	2	0	0	0	0	6
IX	5	1	3	1	5	7
X	8	4	4	5	13	19
XI	9	9	4	7	20	36
XII	4	1	1	1	3	15
XIII	2	1	0	1	2	10
XIV	4	1	0	0	1	9
XV	3	1	0	1	2	9
XVI	3	1	0	0	1	6
Total	59	31	23	29	83	181

Table 8. (Continued)

	Replacements 1967-1968	Projected replacements 1968-1969	Projected replacements 1969-1970	Projected replacements 1970-1971	Total projected replacements	Total number firms
Multi-area firms						
Distributor	10	10	10	10	30	75
Utility A	-	4	4	4	12	1
Utility B	-	-	1	2	3	1
Total	10	14	15	16	45	77
Total all firms	69	45	38	45	128	258

Utilizing data from Table 7 concerning the change in the employment level of major household appliance service technicians from 1967 to 1968, and combining with them the number of appliance service technicians replaced during the same period from Table 8, it is possible to determine the minimum number of vacancies occurring during that time. The reported change in employment level was an increase of 40 technicians. Adding the 69 replacements to this figure gives a total number of vacancies occurring during the year of 109. Available information did not disclose the source of these replacement and additional technicians.

Information concerning ages of appliance service technicians

The median age of the appliance service technicians reported in Table 9 was 36.2 years. One hundred ninety-five technicians were reported to be from 20 to 29 years of age. Two hundred sixty-four were classified in the category 30 to 39. In the category 40 to 49, 159 technicians were listed. Seventy-four were listed in the category 50 to 59. Twenty-three were in the category 60 to 65 and four were listed as being over 65.

Area XIV reported the oldest median age. It was 45.0 years. Area XIII reported the youngest median age, that of 31.0 years. Of the three multi-area firms, utility A reported the oldest median age with 41.0.

Three of the four technicians over 65 years old were listed in the firm size of one or two technicians. The other was employed by a firm employing three or four technicians. Two of these individuals were in Merged Area VII, with one each in Merged Area X and Merged Area XIV.

Information concerning wages of appliance service technicians

The distribution of wages paid to major household appliance service technicians is listed in Table 10, page 52. The median wage for each firm category was computed and is reported in Table 10.

Comparing the wages received on the basis of the population within the merged areas failed to reveal a definite relationship between population and wages. Areas IX and X rated second and third both in high population and high

Table 9. Ages of appliance service technicians

	20-29 years	30-39 years	40-49 years	50-59 years	60-65 years	Over 65 years	Median age
Firm size							
1-2 technicians	47	60	43	19	9	3	37.3
3-4 technicians	32	39	32	9	3	1	36.7
5-6 technicians	4	5	8	2	1	0	41.3
7-8 technicians	10	9	4	6	3	0	36.7
9-10 technicians	3	5	2	0	0	0	34.0
over 10 technicians	19	43	17	11	4	0	36.5
Total	115	161	106	47	20	4	36.9
Iowa merged area							
I	3	2	2	1	1	0	37.5
II	6	5	0	3	1	0	33.0
III	4	4	1	0	0	0	31.3
IV	4	4	3	0	1	0	35.0
V	10	11	7	4	1	0	35.9
VI	0	4	1	1	0	0	35.0
VII	10	13	8	6	2	2	38.1
VIII	4	5	4	2	0	0	37.0
IX	4	6	4	4	1	0	39.2
X	22	40	23	10	3	1	36.8
XI	22	38	27	8	5	0	37.4
XII	9	11	10	2	1	0	36.8
XIII	7	6	3	0	1	0	31.0
XIV	3	2	7	2	2	1	45.0
XV	2	6	3	3	1	0	39.2
XVI	5	4	3	1	0	0	33.8
Total	115	161	106	47	20	4	36.9

Table 9. (Continued)

	20-29 years	30-39 years	40-49 years	50-59 years	60-65 years	Over 65 years	Median age
Multi-area firms							
Distributor	25	55	10	4	0	0	34.0
Utility A	2	11	10	4	1	0	41.0
Utility B	53	37	33	19	2	0	35.1
Total	80	103	53	27	3	0	35.1
Total all firms	195	264	159	74	23	4	36.2

wages. However, Area XI which rated first in population placed seventh in salaries.

No relationship was clearly evident when the wages were compared on the basis of the location of the merged areas within the state.

When wages were compared on the basis of firm size, the salaries generally increased as the size of the firm increased.

Approximately 70 percent of the technicians identified in this study received between $2.50 and $3.99 per hour. One and three tenths percent of the technicians received less than $1.49, while 1.8 percent received over $5.00 per hour.

The 711 appliance service technicians reported in this study command an annual payroll of approximately $4.7 million.

Table 10. Wages received by appliance service technicians

	$1.00-$1.49	$1.50-$1.99	$2.00-$2.49	$2.50-$2.99	$3.00-$3.49	$3.50-$3.99	$4.00-$4.49	$4.50-$4.99	$5.00 and over	Total number of technicians	Median
Firm size											
1-2 technicians	3	14	34	46	42	13	12	2	8	174	$2.89
3-4 technicians	1	8	23	24	24	15	14	5	5	119	3.07
5-6 technicians	0	0	1	9	9	1	0	0	0	20	3.00
7-8 technicians	0	0	0	7	14	6	0	0	0	27	3.23
9-10 technicians	0	0	0	4	6	5	0	0	0	15	3.29
over 10 technicians	0	0	4	8	34	51	0	0	0	97	3.52
Total	4	22	62	98	129	91	26	7	13	452	$3.16
Iowa merged area											
I	0	0	1	2	3	1	2	0	0	9	$3.25
II	1	1	7	1	2	2	0	0	1	15	2.39
III	0	0	1	6	2	0	0	0	0	9	2.79
IV	0	5	1	4	0	2	0	0	0	12	2.50
V	0	2	9	11	6	1	1	1	0	31	2.70
VI	0	1	1	0	2	1	0	0	0	5	3.13
VII	0	2	4	5	7	9	8	1	3	39	3.58
VIII	0	1	2	2	9	0	1	0	0	15	3.14
IX	0	1	0	4	5	7	1	0	0	18	3.40
X	1	1	10	9	25	47	3	0	1	97	3.53

Table 10. (Continued)

	$1.00-$1.49	$1.50-$1.99	$2.00-$2.49	$2.50-$2.99	$3.00-$3.49	$3.50-$3.99	$4.00-$4.49	$4.50-$4.99	$5.00 and over	Total number of technicians	Median
XI	1	5	7	28	39	13	6	4	0	103	$3.13
XII	0	2	2	14	10	2	1	0	2	33	2.95
XIII	1	0	9	2	1	0	1	0	0	14	2.33
XIV	0	1	3	2	9	3	2	1	0	21	3.25
XV	0	0	2	2	8	3	0	0	3	18	3.31
XVI	0	0	3	6	1	0	0	0	3	13	2.94
Total	4	22	62	98	129	91	26	7	13	452	$3.16
Percentage	.9%	4.9%	13.7%	21.7%	28.5%	20.1%	5.8%	1.5%	2.9%		
Multi-area firms											
Distributor	5	10	30	30	16	0	0	0	0	91	$2.51
Utility A	0	0	0	0	9	15	0	0	0	24	3.60
Utility B	0	0	17	64	25	23	15	0	0	144	2.93
Total	5	10	47	94	50	38	15	0	0	259	$2.86
Total all firms	9	32	109	192	179	129	41	7	13	711	$3.04
Percentage	1.3%	4.5%	15.3%	27.0%	25.1%	18.1%	5.7%	1.0%	1.8%		

The figures presented as hourly wages in some instances may represent an approximation by the reporting firm. While the wages were recorded as reported, several firms indicated that they could not give an exact hourly wage because of such factors as profit sharing, commissions, and bonuses paid to their appliance service technicians.

Information concerning training received by appliance service technicians

In an attempt to determine the source of training utilized by major household appliance service technicians, the employing firms were asked to separate the number of service technicians in their employ into five training categories. These categories were: (1) high school vocational courses, (2) vocational or trade school, (3) manufacturer's training courses, (4) experience only, and (5) other sources of training. Many of the service technicians were placed into more than one category by their employers. This information is recorded in Table 11.

Of the 460 technicians reported from the 16 merged areas, 33 had received high school vocational courses in preparation for the occupation. Attendance at a vocational or trade school was indicated for 81. The majority, 250, had received instruction through manufacturer's training courses. One hundred fifty-five had experience only.

Utility B reported that the only training received by its technicians was through the company training program. Twenty-nine other technicians had received training other than the types discussed above. Most of these indicated

Table 11. Source of training of appliance service technicians

	High school vocational courses	Vocational or trade school	Manufacturers training courses	Experience only	Other sources of training
Firm size					
1-2 technicians	13	34	99	61	23
3-4 technicians	14	25	68	35	6
5-6 technicians	1	4	18	0	0
7-8 technicians	2	6	19	6	0
9-10 technicians	2	2	8	2	0
over 10 technicians	1	10	38	51	0
Total	33	81	250	155	29
Iowa merged area					
I	1	2	4	4	1
II	0	2	5	5	1
III	1	1	3	5	3
IV	2	1	7	6	0
V	4	9	17	14	2
VI	2	2	2	2	1
VII	1	7	29	11	0
VIII	0	4	14	1	0
IX	1	4	6	8	0
X	5	14	49	38	1
XI	11	12	56	40	1
XII	4	9	19	8	2
XIII	1	5	10	3	1
XIV	0	2	10	6	13
XV	0	6	10	1	2
XVI	0	1	9	3	1
Total	33	81	250	155	29
Percent of technicians employed 1968	7.2	17.6	54.3	33.7	6.3

Table 11. (Continued)

	High school vocational courses	Vocational or trade school	Manufacturers training courses	Experience only	Other sources of training
Multi-area firms					
Distributor	0	10	85	0	0
Utility A	0	0	15	9	0
Utility B	0	0	0	0	144
Total	0	10	100	9	144
Total all firms	33	91	350	164	173
Percent all technicians employed 1968	4.6	12.7	48.7	22.4	24.1

a company training program as preparation for the occupation, while a few indicated that training had been received in the military service.

Findings Related to Part-time Training Programs

When asked to list the number of appliance service technicians employed by them, who would benefit from part-time educational programs in the trade, the merged area firms responded with a total of 250. This represents 54.3 percent of the major household appliance service technicians employed in 1968.

Utility A reported ten to 12. Utility B reported 144, their entire technician service force (see Table 12).

The firms were then asked to list the number of technicians that they would encourage to attend such part-time programs if such part-time programs were to be made available. The merged area firms reported a total of 269. This was 19 more than they reported as being able to benefit from such a course. Utility A and utility B held to the same figures listed in the previous category.

Assuming that all who would benefit from a part-time program and all that were encouraged to attend would not do so, the employers were asked to indicate how many they thought would actually attend. The number listed by the merged area firms was 206. The distributor which had not responded to the first two items of this series listed ten. Utility A indicated that all of those who were encouraged to attend would do so. Utility B, however, cut its figure from 144 on the two previous items down to 36.

In all, of the 719 service technicians listed as employed in 1968, 405 were thought to be able to benefit from part-time occupational training programs. Four hundred twenty-four would be encouraged to attend part-time training programs by their employers. However, only 253 were thought to be individuals who would actually attend.

The responses to this series of items were contingent upon the offering of part-time training programs for appliance service technicians by the area vocational schools and the community colleges throughout the state of Iowa.

Table 12. Employer attitudes about additional training needs of appliance service technicians

	Number of technicians who would benefit from part-time programs	Number of technicians who would be encouraged to attend part-time programs	Number of technicians who would probably attend part-time programs
Firm size			
1-2 technicians	119	128	104
3-4 technicians	47	63	45
5-6 technicians	11	8	2
7-8 technicians	19	23	18
9-10 technicians	10	0	7
over 10 technicians	44	47	30
Total	250	269	206
Iowa merged area			
I	3	3	3
II	14	14	13
III	5	5	5
IV	6	12	7
V	22	23	20
VI	5	4	3
VII	27	25	13
VIII	4	5	5
IX	12	11	9
X	47	55	42
XI	45	51	39
XII	17	11	8
XIII	8	9	8
XIV	12	16	15
XV	13	14	10
XVI	10	11	6

Table 12. (Continued)

	Number of technicians who would benefit from part-time programs	Number of technicians who would be encouraged to attend part-time programs	Number of technicians who would probably attend part-time programs
Total	250	269	206
Percent of technicians employed 1968 in merged areas	54.3	58.5	44.8
Multi-area firms			
Distributor	-	-	10
Utility A	10-12	10-12	10-12
Utility B	144	144	36
Total	154-156	154-156	56-58
Total technicians	405	424	253
Percent of all technicians employed 1968	56.3	59.0	35.2

A complete distribution of responses by the various groupings of firms is given in Table 12.

Findings Related to Training Needs of Appliance Service Technicians

This section describes the findings concerning various items of knowledge and skill, and their relative importance to appliance service technicians. These items are divided into 11 categories. They are: (1) mathematics, (2) English, (3) business practices, (4) electrical information, (5) chemistry, (6) physics, (7) thermodynamics, (8) theory and structure of appliance mechanisms, (9) theory and operation of appliance controls, (10) instruments, and (11) operations or skills.

Tables 13 through 23 report the ratings assigned to each item by appliance service technician employers. The number of firms assigning each rating is reported along with the mean rating for each item. The ratings were based on a five-point scale. The scale is as follows: (1) very little importance, (2) background knowledge only, (3) desirable, (4) highly desirable, and (5) essential.

The items in each table are reported in order of descending importance as determined by the mean rating of each from all firms. Provision was made on the questionnaire for the respondents to add items they felt were of importance. These additional items are reported in the text rather than in the tables because there were few firms listing identical items.

Composite ratings

Mathematics Only two general items of mathematics were listed in the questionnaire for rating. The basic mathematics were perceived by the

respondents to be more important than the more advanced mathematics. Table 13 shows the various ratings assigned to the items of mathematics.

Table 13. Importance of mathematics to major household appliance service technicians, as reported by employers

Topic item	Rating					
	1	2	3	4	5	Mean
Basic mathematics including common fractions, decimal fractions, powers and roots of numbers, shop computations involving measurement and conversion factors, etc.	26	26	<u>47</u>	31	22	2.98
More advanced mathematics including solving algebraic problems with one and two unknowns, solving simultaneous equations, trigonometric relationships, etc.	<u>80</u>	37	29	4	3	1.78

Rating scale:

1 - very little importance
2 - background knowledge only
3 - desirable
4 - highly desirable
5 - essential

Rating most often listed is underscored.

Additional items of mathematics thought to be important by individual respondents were: practical math, accuracy with figures, figuring costs, and figuring bills.

English Four items of English were presented for rating. Three of these items--ability to write correctly, ability to spell, and knowledge of sentence structure--were rated desirable while skill in the use of words was rated at less than 2.00 (see Table 14).

Table 14. Importance of English to major household appliance service technicians, as reported by employers

Topic item	Rating					
	1	2	3	4	5	Mean
Ability to write grammatically correct reports and letters	12	16	56	46	29	3.40
Good spelling skills	10	7	78	41	23	3.38
Knowledge of sentence structure	17	26	76	23	13	2.93
Skill in use of words	71	50	26	5	4	1.85

Rating scale:

1 - very little importance
2 - background knowledge only
3 - desirable
4 - highly desirable
5 - essential

Rating most often listed is underscored.

Items of English which were felt by the employers to be of importance to the technicians, in addition to the ones listed above, consisted of: penmanship, speech and vocabulary, and "clean vocabulary".

Business practices The item rated most important by employers in the category of business practices was "ability to talk with customer". The item rated least important was "knowledge of accounting procedures". All other items except "knowledge of marketing procedures" and "knowledge of accounting procedures" rated desirable or better (see Table 15).

Additional business practice items mentioned by employers were: follow instructions, be prompt, neatness in dress, pleasant and courteous attitude, knowledge of when to sell new product instead of repairing appliance, knowledge of product, skill in human relations, say very little and get on with the job, and the desire to improve.

Electrical information All items in this category rated above desirable except "Wye and Delta systems", which rated 2.77. The highest ratings were assigned to "electrical safety" and "reading wiring diagrams". Table 16, page 65, shows the complete rating distributions of all electrical items.

Additional comments concerning items of electrical information included: be able to do wiring, knowledge of electricity and installation problems, and emphasis on minor trouble.

Chemistry Table 17, page 66, provides data concerning chemistry and its importance to appliance service technicians. Of the items listed, "effects of detergents, bleaches, etc." rated the highest. "Basic reactions" rated as the least important.

Table 15. Importance of business practices to major household appliance service technicians, as reported by employers

Topic item	Rating					
	1	2	3	4	5	Mean
Ability to talk with customer	2	1	13	50	<u>99</u>	4.47
Show interest in customer	3	1	10	59	<u>94</u>	4.44
Ability to estimate repair costs prior to work	2	3	22	55	<u>84</u>	4.30
Ability to handle warranties and service policies	3	10	28	49	<u>61</u>	4.03
Skill in the use of public relations	4	9	35	<u>64</u>	47	3.89
Have good physical appearance	4	4	40	<u>54</u>	52	3.81
Skilled in the art of salesmanship	4	9	41	<u>72</u>	34	3.71
Knowledge of marketing procedures	27	<u>50</u>	<u>50</u>	19	7	2.54
Knowledge of accounting procedures	26	48	<u>55</u>	16	4	2.49

Rating scale:

1 - very little importance
2 - background knowledge only
3 - desirable
4 - highly desirable
5 - essential

Rating most often listed is underscored.

Table 16. Importance of electrical information to the major household appliance service technicians, as reported by employers

Topic item	Rating					
	1	2	3	4	5	Mean
Electrical safety	2	2	17	40	104	4.47
Reading wiring diagrams	2	2	20	37	101	4.44
Parallel circuits	2	9	37	51	58	3.98
Series circuits	2	9	39	53	57	3.96
Single phase, 3-wire installations	6	17	38	36	62	3.82
Basic electricity including electron theory, sources of production of electricity, electrical and electronic symbols, ohm's law, magnetism, and electromagnetism	7	18	38	49	50	3.72
A-C single phase power	6	19	44	44	44	3.64
Three-phase, 3-wire installations	14	13	46	32	50	3.59
A-C power and power factor	6	23	50	41	39	3.47
Fundamental solid state theory	9	23	51	43	35	3.45
Capacitance and capacitive reactance	7	29	47	43	31	3.39
Inductance and inductive reactance	6	30	47	45	27	3.37
Electromagnetism	14	24	53	30	31	3.26
Basic direct current	19	18	37	36	27	3.25
A-C polyphase power	18	26	56	23	16	2.77

Rating scale:

1 - very little importance
2 - background knowledge only
3 - desirable
4 - highly desirable
5 - essential

Rating most often listed is underscored.

Table 17. Importance of chemistry to the major household appliance service technicians, as reported by employers

Topic item	Rating					
	1	2	3	4	5	Mean
Effects of detergents, bleaches, etc.	15	25	27	<u>39</u>	24	3.25
Corrosion	13	39	<u>54</u>	34	20	3.06
Water chemistry	23	42	<u>49</u>	28	14	2.79
Chemistry of refrigerants	13	29	<u>43</u>	35	41	2.71
Basic reactions	35	47	<u>49</u>	14	14	2.53

Rating scale:

1 - very little importance
2 - background knowledge only
3 - desirable
4 - highly desirable
5 - essential

Rating most often listed is underscored.

Items not included on questionnaire but thought to be important by employers were: refrigeration formulas and chemical relationships to heat transfer by compression and electrical wiring of fractional house power.

<u>Physics</u> All items concerning physics rated above 3.00 or desirable. No great differentiation between items was noted. Table 18 presents the distribution of responses.

Table 18. Importance of physics to the major household appliance service technicians, as reported by employers

Topic item	Rating					
	1	2	3	4	5	Mean
Air-gas mixture in combustion	16	30	31	33	<u>45</u>	3.39
Heat of compression	19	26	<u>48</u>	40	27	3.19
Heat of vaporization	20	24	<u>48</u>	39	25	3.16
Mechanical advantage	18	28	<u>50</u>	40	25	3.16
Sensible heat	17	24	<u>54</u>	39	22	3.16
Latent heat	20	27	<u>52</u>	35	21	3.06

Rating scale:

1 - very little importance
2 - background knowledge only
3 - desirable
4 - highly desirable
5 - essential

Rating most often listed is underscored.

The use of vacuum pumps was suggested for inclusion in the category of physics.

<u>Thermodynamics</u> The items listed under thermodynamics rated slightly less than highly desirable (see Table 19).

Table 19. Importance of thermodynamics to major household appliance service technicians, as reported by employers

Topic item	Rating					
	1	2	3	4	5	Mean
Effects of temperature on gases and liquids	7	16	38	40	<u>55</u>	3.77
Effects of vaporization in refrigeration	8	15	43	35	<u>56</u>	3.74
Effects of compression of gases in refrigeration	8	16	43	37	<u>52</u>	3.70

Rating scale:

1 - very little importance
2 - background knowledge only
3 - desirable
4 - highly desirable
5 - essential

Rating most often listed is underscored.

<u>Theory and structure of appliance mechanisms</u> The importance of understanding of the theory and structure of appliance mechanisms rated highly desirable when the items are grouped as a whole. The individual ratings assigned to each mechanism is given in Table 20.

Items listed as important but not included on the questionnaire were relays and solid state controls.

Table 20. Importance of the theory and structure of appliance mechanisms to the major household appliance service technicians, as reported by employers

Topic item	Rating					
	1	2	3	4	5	Mean
Fans and blowers	2	1	25	47	<u>84</u>	4.32
Solenoids	2	0	26	50	<u>84</u>	4.32
Heating elements	2	0	26	50	<u>82</u>	4.31
Timers	2	1	25	53	<u>84</u>	4.31
Pumps	4	2	24	43	<u>86</u>	4.29
Compressors	6	0	24	46	<u>85</u>	4.27
Motors	2	3	30	44	<u>86</u>	4.26
Gas ignition	5	5	25	47	<u>77</u>	4.17
Burners	4	2	32	44	<u>74</u>	4.17
Transmissions	4	8	25	50	<u>75</u>	3.95

Rating scale:

1 - very little importance
2 - background knowledge only
3 - desirable
4 - highly desirable
5 - essential

Rating most often listed is underscored.

Theory and operation of appliance controls Eight items thought to be of importance in the realm of the theory and operation of appliance controls were rated by the employers of appliance service technicians. All items in this category rated above highly desirable. Table 21 gives the distribution of the ratings.

Table 21. Importance of the theory and operation of appliance controls to the major household appliance service technicians, as reported by employers

Topic item	Rating					Mean
	1	2	3	4	5	
Timers	1	1	17	47	96	4.46
Thermostats	1	1	20	43	98	4.45
Switches	1	1	20	47	94	4.42
Overload protection	2	2	21	44	93	4.38
Temperature and its effect	2	4	23	46	86	4.30
Motor speed	2	3	27	48	81	4.26
Water level	3	2	26	47	76	4.24
Humidistat	3	8	28	38	85	4.20

Rating scale:

1 - very little importance
2 - background knowledge only
3 - desirable
4 - highly desirable
5 - essential

Rating most often listed is underscored.

Instruments Ten instruments were listed for rating by the employers. The relative importance of each as being included in any course of study for appliance service technicians rated from desirable to highly desirable. The specific ratings for each instrument are shown in Table 22.

In addition to the instruments listed in Table 21, the tachometer was suggested for inclusion.

Table 22. Importance of instruments to the major household appliance service technician, as reported by employers

Topic item	Rating					
	1	2	3	4	5	Mean
Leak detector for gas	6	6	20	37	89	4.25
Leak detector for refrigerant	6	3	24	40	89	4.25
Ohmmeter	2	5	27	47	85	4.25
Dial thermometer	6	8	35	49	57	3.92
Oven testers	8	9	36	49	60	3.89
Multimeter	10	11	35	34	61	3.83
Time and temperature recorder	8	13	34	53	50	3.78
Hygrometer	23	28	48	30	19	2.96
Psychrometer	21	29	49	28	18	2.95
Psychrometric slide rule	36	24	48	24	14	2.70

Rating scale:

1 - very little importance
2 - background knowledge only
3 - desirable
4 - highly desirable
5 - essential

Rating most often listed is underscored.

Operations and skills The operations listed in Table 23 rated above 3.00. In addition to the skills and operations listed, skill in use of tools and care of tools were added by respondents.

Table 23. Importance of operations and skills to major household appliance service technicians, as reported by employers

Operational items	Rating					
	1	2	3	4	5	Mean
Soldering	4	28	5	48	<u>82</u>	4.05
Simple house wiring	5	7	42	45	<u>66</u>	3.97
Estimating air conditioning load	9	12	44	46	<u>52</u>	3.74
Brazing	14	10	43	<u>52</u>	48	3.66
Pipe threading	15	18	38	37	<u>50</u>	3.56
Welding	14	23	<u>47</u>	42	39	3.42

Rating scale:

1 - very little importance
2 - background knowledge only
3 - desirable
4 - highly desirable
5 - essential

Rating most often listed is underscored.

Mean ratings by firms servicing specific appliances

Tables 24 through 34 give the mean ratings assigned to the various items based on the importance attached to each item by 15 groups of firms. The firms were grouped according to the appliance or appliances reported to be most often serviced by the respective firms. The number in parentheses beside each mean, indicates the number of responses contributing to that mean.

Mathematics Those firms listing "range" as the most frequently serviced appliance rated the general category of mathematics higher than did any other group of firms. The groups "clothes dryer" and "washer and dryer" attached the least importance to it. Table 24 shows the mean of the ratings of importance attached to each item by each firm classification.

English The firm classification "all appliances listed" rated English more highly than did any other classification group. English was rated lowest by the "dryer and range" and the "none of the appliances listed" groups. The ratings by these two groups was less meaningful however, because of the number of contributing firms and the number of items to which no response was made (see Table 25, page 76).

Business practices Table 26, page 78, deals with business practices and their importance to the appliance service technician. Those firm groups generally rating business practices high were "clothes dryer", "dishwasher", "conventional washer", and "refrigerator and range". Least importance was assigned to business practices by the "dryer and range" group of firms.

Table 24. Importance of mathematics to major household appliance service technicians, as reported by employers, by appliance most frequently serviced

Topic item	Room air conditioner	Range	Clothes washer	Refrigerator and freezer	Clothes dryer	Dishwasher	Air conditioner refrigerator and freezer	Washer and dryer
	a	b	c	d	e	f	g	h
Basic mathematics including common fractions, powers and roots of numbers, shop computations involving measurements and conversion factors, etc.	3.50 (4)	3.75 (4)	3.01 (71)	3.09 (23)	2.33 (3)	4.00 (2)	3.25 (12)	2.46 (13)
More advanced mathematics including solving algebraic problems with one and two unknowns, involving simultaneous equations, trigonometric relationships, etc.	2.00 (4)	3.00 (4)	1.69 (70)	1.67 (24)	1.33 (3)	1.50 (2)	1.73 (11)	1.19 (11)

Table 24. (Continued)

Topic item	All appliances listed i	None of the appliances listed k	Washer and refrigerator n	Dryer and range p	Conventional washer q	Refrigerator and range s	Air conditioner and washer t
Basic mathematics including common fractions, powers and roots of numbers, shop computations involving measurement and conversion factors, etc.	3.00 (6)	4.00 (1)	3.00 (2)	4.00 (1)	4.00 (1)	3.00 (1)	3.00 (1)
More advanced mathematics including solving algebraic problems with one and two unknowns, involving simultaneous equations, trigonometric relationships, etc.	2.83 (6)	1.00 (1)	1.00 (1)	0.00 (0)	2.00 (1)	2.00 (1)	1.00 (1)

The number in parentheses indicates the number of responses.

Table 25. Importance of English to major household appliance service technicians, as reported by employers, by appliance most frequently serviced

Topic item	Room air conditioner	Range	Clothes washer	Refrigerator and freezer	Clothes dryer	Dishwasher	Air conditioner refrigerator and freezer	Washer and dryer
	a	b	c	d	e	f	g	h
Ability to write grammatically correct reports and letters	3.50 (4)	3.25 (4)	3.53 (76)	3.34 (26)	4.00 (3)	3.00 (2)	3.00 (13)	3.77 (13)
Good spelling skills	3.25 (4)	3.75 (4)	3.28 (76)	3.50 (26)	3.67 (3)	3.00 (2)	2.54 (13)	3.43 (14)
Knowledge of sentence structure	3.25 (4)	3.00 (4)	2.91 (75)	2.64 (28)	2.67 (3)	4.00 (2)	2.44 (13)	3.00 (12)
Skill in use of words	3.25 (4)	3.50 (4)	3.60 (77)	2.86 (29)	3.67 (3)	4.50 (2)	3.31 (13)	4.17 (12)

Table 25. (Continued)

Topic item	All appliances listed i	None of the appliances listed k	Washer and refrigerator n	Dryer and range p	Conventional washer q	Refrigerator and range s	Air conditioner and washer t
Ability to write grammatically correct reports and letters	4.00 (5)	5.00 (1)	3.50 (2)	0.00 (0)	4.00 (1)	3.00 (1)	3.00 (1)
Good spelling skills	4.20 (5)	0.00 (0)	3.00 (2)	0.00 (0)	5.00 (1)	5.00 (1)	3.00 (1)
Knowledge of sentence structure	3.60 (5)	0.00 (0)	3.00 (2)	4.00 (1)	4.00 (1)	3.00 (1)	3.00 (1)
Skill in use of words	4.00 (6)	0.00 (0)	3.50 (2)	0.00 (0)	4.00 (1)	3.00 (1)	0.00 (0)

The number in parentheses indicates the number of responses.

Table 26. Importance of business practices to major household appliance service technicians, as reported by employers, by appliance most frequently serviced

Topic item	Room air conditioner a	Range b	Clothes washer c	Refrigerator and freezer d	Clothes dryer e	Dishwasher f	Air conditioner refrigerator and freezer g	Washer and dryer h
Ability to talk with customer	4.25 (4)	3.75 (4)	4.39 (79)	4.52 (27)	4.67 (3)	5.00 (2)	4.76 (13)	4.71 (14)
Show interest in customer	4.25 (4)	3.75 (4)	4.30 (81)	4.57 (28)	4.67 (3)	4.50 (2)	4.50 (12)	4.71 (14)
Ability to estimate repair costs prior to work	4.00 (4)	3.50 (4)	4.29 (79)	4.32 (28)	4.33 (3)	4.50 (2)	4.64 (13)	4.43 (14)
Ability to handle warranties and service policies	3.50 (4)	3.25 (4)	4.01 (79)	3.67 (30)	4.00 (3)	4.00 (2)	4.31 (13)	4.46 (13)
Skilled in the use of public relations	4.50 (4)	3.75 (4)	3.98 (77)	3.69 (26)	3.67 (3)	4.00 (2)	3.23 (13)	3.92 (13)
Have good physical appearance	4.00 (4)	3.50 (4)	3.92 (79)	4.12 (25)	4.67 (3)	4.00 (2)	3.92 (13)	4.21 (14)
Skilled in the art of salesmanship	4.50 (4)	3.25 (4)	3.73 (79)	3.76 (25)	3.67 (3)	4.00 (2)	3.46 (13)	4.00 (13)
Knowledge of marketing procedures	2.50 (4)	2.75 (4)	2.48 (76)	2.61 (23)	2.67 (3)	3.50 (2)	2.62 (13)	2.54 (13)
Knowledge of accounting procedures	1.75 (4)	2.75 (4)	2.48 (76)	2.56 (23)	3.00 (3)	2.50 (2)	2.62 (13)	2.33 (12)

Table 26. (Continued)

Topic item	All appliances listed i	None of the appliances listed k	Washer and refrigerator n	Dryer and range p	Conventional washer q	Refrigerator and range s	Air conditioner and washer t
Ability to talk with customer	4.67 (6)	5.00 (1)	5.00 (2)	5.00 (1)	5.00 (1)	5.00 (1)	4.00 (1)
Show interest in customer	4.67 (6)	5.00 (1)	4.50 (2)	5.00 (1)	5.00 (1)	5.00 (1)	4.00 (1)
Ability to estimate repair costs prior to work	4.67 (6)	5.00 (1)	4.50 (2)	4.00 (1)	5.00 (1)	5.00 (1)	4.00 (1)
Ability to handle warranties and service policies	4.20 (5)	5.00 (2)	4.50 (2)	0.00 (0)	5.00 (1)	5.00 (1)	4.00 (1)
Skilled in the use of public relations	3.50 (6)	0.00 (0)	4.50 (2)	4.00 (1)	5.00 (1)	3.00 (1)	4.00 (1)
Have good physical appearance	4.33 (6)	5.00 (1)	4.00 (2)	0.00 (0)	5.00 (1)	5.00 (1)	4.00 (1)
Skilled in the art of salesmanship	4.20 (6)	0.00 (0)	3.50 (2)	4.00 (1)	5.00 (1)	3.00 (1)	4.00 (1)
Knowledge of marketing procedures	3.00 (5)	0.00 (0)	2.50 (2)	0.00 (0)	3.00 (1)	3.00 (1)	3.00 (1)
Knowledge of accounting procedures	3.00 (5)	0.00 (0)	2.50 (2)	0.00 (0)	3.00 (1)	3.00 (1)	1.00 (1)

The number in parentheses indicates the number of responses.

Electrical information The importance assigned to the various items of electrical information is shown in Table 27. The number of firms responding in each firm group should be considered before any interpretations are made.

Chemistry The importance of chemistry to appliance service technicians is given in Table 28, page 85. The average rating for each group of firms for chemistry is smaller than the same measure for electrical information with the exception of the "clothes dryer" and "conventional washer" groups.

Physics Physics rated higher than chemistry in most firm groups. Most of the exceptions fell within the groups where there were few respondents. The means indicating importance are shown in Table 29, page 87.

Thermodynamics Thermodynamics received the rating indicating the greatest importance from firms placed in categories in which refrigeration was involved. This could have probably been anticipated due to the nature of the items. However, the firms listing room air conditioners as the appliance serviced most often did not place the same amount of emphasis on these items as did the other refrigeration groups (see Table 30, page 89).

Theory and structure of appliance mechanism The theory and structure of appliance mechanisms received relatively high importance from all firm groups with the exception of three groups which included very few respondents. Table 31, page 91, shows the complete listing of means assigned by the various groups to all items of theory and structure of appliance mechanisms.

Table 27. Importance of electrical information to major household appliance service technicians, as reported by employers, by appliance most frequently serviced

Topic item	Room air conditioner a	Range b	Clothes washer c	Refrigerator and freezer d	Clothes dryer e	Dishwasher f	Air conditioner refrigerator and freezer g	Washer and dryer h
Electrical safety	4.25 (4)	3.75 (4)	4.47 (79)	4.41 (27)	4.33 (3)	5.00 (2)	4.76 (13)	4.43 (14)
Reading wiring diagrams	3.67 (3)	3.75 (4)	4.46 (79)	4.31 (26)	4.67 (3)	4.50 (2)	4.31 (13)	4.64 (14)
Parallel circuits	3.25 (4)	3.75 (4)	3.79 (77)	4.64 (25)	3.67 (3)	4.50 (2)	4.31 (13)	4.00 (12)
Series circuits	3.25 (4)	3.75 (4)	3.79 (77)	4.12 (26)	3.67 (3)	4.50 (2)	4.31 (13)	4.08 (13)
Single phase, 3-wire installations	3.75 (4)	3.75 (4)	3.72 (78)	4.20 (25)	2.67 (3)	5.00 (2)	4.00 (13)	3.62 (13)
Basic electricity including electron theory, sources and production of electricity, electrical and electronic symbols, ohm's law, magnetism, and electromagnetism	3.50 (4)	3.25 (4)	3.74 (79)	4.04 (26)	3.00 (3)	3.50 (2)	3.62 (13)	3.69 (13)
A-C single phase power	3.00 (4)	3.25 (4)	3.65 (77)	4.12 (25)	3.00 (3)	4.00 (2)	3.69 (13)	3.00 (12)

Table 27. (Continued)

Topic item	Room air conditioner a	Range b	Clothes washer c	Refrigerator and freezer d	Clothes dryer e	Dishwasher f	Air conditioner refrigerator and freezer g	Washer and dryer h
Three phase, 3-wire installations	3.25 (4)	3.50 (4)	3.58 (76)	4.12 (26)	1.33 (3)	5.00 (2)	3.76 (13)	3.25 (12)
A-C power and power factor	3.00 (4)	3.00 (4)	3.38 (77)	3.88 (26)	3.00 (3)	4.00 (2)	3.77 (13)	3.15 (13)
Fundamental solid state theory	3.50 (4)	3.00 (4)	3.41 (79)	3.61 (23)	2.67 (3)	3.50 (2)	3.23 (13)	3.41 (14)
Capacitance and capacitive reactance	3.00 (4)	3.00 (4)	3.36 (76)	3.61 (26)	2.00 (3)	3.50 (2)	3.46 (13)	3.15 (13)
Inductance and inductive reactance	3.00 (4)	3.25 (4)	3.26 (76)	3.74 (23)	2.00 (3)	3.50 (2)	3.46 (13)	3.00 (13)
Electromagnetism	3.25 (4)	3.00 (4)	3.22 (77)	3.77 (22)	2.00 (3)	2.50 (2)	3.15 (13)	3.08 (13)
Basic direct current	3.33 (3)	3.25 (4)	3.31 (71)	3.33 (18)	2.33 (3)	2.00 (2)	3.22 (9)	2.83 (12)
A-C polyphase power	2.00 (4)	3.00 (4)	3.03 (75)	3.72 (25)	2.33 (3)	3.00 (2)	3.38 (13)	2.67 (12)
Wye and Delta systems	1.75 (4)	2.75 (4)	2.64 (73)	3.22 (23)	2.33 (3)	3.00 (2)	3.23 (13)	2.46 (13)

Table 27. (Continued)

Topic item	All appliances listed i	None of the appliances listed k	Washer and refrigerator n	Dryer and range p	Conventional washer q	Refrigerator and range s	Air conditioner and washer t
Electrical safety	4.83 (6)	5.00 (1)	4.00 (2)	5.00 (1)	5.00 (1)	5.00 (1)	5.00 (1)
Reading wiring diagrams	4.83 (6)	5.00 (1)	5.00 (2)	5.00 (1)	5.00 (1)	5.00 (1)	5.00 (1)
Parallel circuits	4.40 (5)	0.00 (0)	5.00 (2)	4.00 (1)	5.00 (1)	4.00 (1)	5.00 (1)
Series circuits	4.40 (5)	5.00 (1)	5.00 (2)	4.00 (1)	3.00 (1)	4.00 (1)	5.00 (1)
Single phase, 3-wire installations	3.60 (5)	5.00 (1)	5.00 (2)	2.00 (1)	3.00 (1)	1.00 (1)	5.00 (1)
Basic electricity including electron theory, sources and production of electricity, electrical and electronic symbols, ohm's law, magnetism, and electromagnetism	4.00 (6)	0.00 (0)	2.50 (2)	4.00 (1)	5.00 (1)	5.00 (1)	3.00 (1)
A-C single phase power	3.80 (5)	5.00 (1)	5.00 (2)	3.00 (1)	5.00 (1)	2.00 (1)	5.00 (1)
Three phase, 3-wire installations	3.60 (5)	5.00 (1)	3.00 (2)	4.00 (1)	3.00 (1)	1.00 (1)	5.00 (1)

Table 27. (Continued)

Topic item	All appliances listed i	None of the appliances listed k	Washer and refrigerator n	Dryer and range p	Conventional washer q	Refrigerator and range s	Air conditioner and washer t
A-C power and power factor	3.80 (5)	5.00 (1)	5.00 (2)	3.00 (1)	5.00 (1)	2.00 (1)	5.00 (1)
Fundamental solid state theory	4.00 (6)	0.00 (0)	3.50 (2)	0.00 (0)	3.00 (1)	4.00 (1)	4.00 (1)
Capacitance and capacitive reactance	4.00 (5)	0.00 (0)	3.50 (2)	4.00 (1)	5.00 (1)	3.00 (1)	5.00 (1)
Inductance and inductive reactance	4.00 (5)	0.00 (0)	3.50 (2)	4.00 (1)	5.00 (1)	3.00 (1)	4.00 (1)
Electromagnetism	3.33 (3)	0.00 (0)	2.00 (2)	4.00 (1)	3.00 (1)	2.00 (1)	3.00 (1)
Basic direct current	3.20 (5)	5.00 (1)	5.00 (1)	4.00 (1)	5.00 (1)	0.00 (0)	3.00 (1)
A-C polyphase power	3.25 (4)	0.00 (0)	2.50 (1)	3.00 (1)	5.00 (1)	2.00 (1)	5.00 (1)
Wye and Delta systems	2.50 (4)	0.00 (0)	4.00 (2)	4.00 (1)	3.00 (1)	1.00 (1)	3.00 (1)

The number in parentheses indicates the number of responses.

Table 28. Importance of chemistry to major household appliance service technicians, as reported by employers, by appliance most frequently serviced

Topic item	Room air conditioner a	Range b	Clothes washer c	Refrigerator and freezer d	Clothes dryer e	Dishwasher f	Air conditioner refrigerator and freezer g	Washer and dryer h
Effects of detergents, bleaches, etc.	2.00 (4)	2.75 (4)	3.29 (79)	3.09 (22)	3.33 (3)	1.50 (2)	3.22 (12)	3.54 (13)
Corrosion	2.75 (4)	3.00 (4)	3.04 (77)	3.08 (25)	4.00 (3)	4.00 (2)	3.08 (13)	2.92 (13)
Water chemistry	2.00 (4)	3.00 (4)	2.74 (77)	2.79 (24)	2.67 (3)	1.50 (2)	2.84 (13)	2.92 (13)
Chemistry of refrigerants	3.25 (4)	3.00 (4)	3.24 (78)	3.71 (24)	2.67 (3)	3.00 (2)	4.15 (13)	3.00 (13)
Basic reactions	2.00 (4)	2.67 (4)	2.36 (77)	2.66 (26)	2.00 (3)	1.50 (2)	2.69 (13)	2.54 (13)

Table 28. (Continued)

Topic item	All appliances listed i	None of the appliances listed k	Washer and refrigerator n	Dryer and range p	Conventional washer q	Refrigerator and range s	Air conditioner and washer t
Effects of detergents, bleaches, etc.	2.40 (5)	0.00 (0)	3.00 (2)	3.00 (1)	5.00 (1)	3.00 (1)	1.00 (1)
Corrosion	3.00 (5)	0.00 (0)	3.00 (2)	3.00 (1)	5.00 (1)	2.00 (1)	3.00 (1)
Water chemistry	2.00 (4)	0.00 (0)	1.00 (2)	3.00 (1)	5.00 (1)	2.00 (1)	3.00 (1)
Chemistry of refrigerants	4.00 (5)	5.00 (1)	4.50 (2)	4.00 (1)	5.00 (1)	2.00 (1)	4.00 (1)
Basic reactions	2.00 (4)	5.00 (1)	2.00 (2)	3.00 (1)	5.00 (1)	3.00 (1)	1.00 (1)

The number in parentheses indicates the number of responses.

Table 29. Importance of physics to major household appliance service technicians, as reported by employers, by appliance most frequently serviced

Topic item	Room air conditioner a	Range b	Clothes washer c	Refrigerator and freezer d	Clothes dryer e	Dishwasher f	Air conditioner refrigerator and freezer g	Washer and dryer h
Air-gas mixture in combustion	2.75 (4)	3.50 (4)	3.17 (76)	3.24 (25)	4.33 (3)	1.50 (2)	3.38 (13)	3.42 (12)
Heat of compression	3.50 (4)	3.25 (4)	2.99 (77)	3.76 (25)	2.00 (3)	1.50 (2)	3.70 (13)	3.00 (13)
Mechanical advantage	3.00 (4)	3.50 (4)	3.00 (78)	3.25 (24)	3.00 (3)	2.50 (2)	3.69 (13)	3.15 (13)
Sensible heat	3.25 (4)	3.25 (4)	2.95 (76)	3.38 (24)	2.76 (3)	2.50 (2)	4.00 (13)	3.23 (13)
Heat of vaporization	3.50 (4)	3.25 (4)	2.91 (76)	3.86 (25)	2.33 (3)	1.50 (2)	3.80 (13)	3.00 (12)
Latent heat	3.25 (4)	3.25 (4)	2.45 (85)	3.50 (24)	2.67 (3)	2.50 (2)	3.80 (13)	3.15 (13)

Table 29. (Continued)

Topic item	All appliances listed i	None of the appliances listed k	Washer and refrigerator n	Dryer and range p	Conventional washer q	Refrigerator and range s	Air conditioner and washer t
Air-gas mixture in combustion	3.40 (5)	0.00 (0)	3.50 (2)	3.00 (1)	3.00 (1)	2.00 (1)	4.00 (1)
Heat of compression	3.20 (5)	5.00 (1)	3.50 (2)	3.00 (1)	3.00 (1)	2.00 (1)	4.00 (1)
Mechanical advantage	3.60 (5)	5.00 (1)	4.00 (2)	3.00 (1)	3.00 (1)	2.00 (1)	4.00 (1)
Sensible heat	3.20 (5)	0.00 (0)	4.00 (2)	3.00 (1)	3.00 (1)	2.00 (1)	4.00 (1)
Heat of vaporization	3.20 (5)	0.00 (0)	4.00 (2)	3.00 (1)	3.00 (1)	2.00 (1)	4.00 (1)
Latent heat	2.80 (5)	0.00 (0)	4.00 (2)	3.00 (1)	3.00 (1)	2.00 (1)	4.00 (1)

The number in parentheses indicates the number of responses.

Table 30. Importance of thermodynamics to major household appliance service technicians, as reported by employers, by appliance most frequently serviced

Topic item	Room air conditioner a	Range b	Clothes washer c	Refrigerator and freezer d	Clothes dryer e	Dishwasher f	Air conditioner refrigerator and freezer g	Washer and dryer h
Effects of temperature on gases and liquids	2.75 (4)	3.00 (4)	3.65 (74)	4.23 (26)	4.00 (3)	1.50 (2)	4.23 (13)	3.77 (13)
Effects of vaporization in refrigeration	2.75 (4)	3.00 (4)	3.65 (74)	4.08 (26)	3.00 (3)	1.50 (2)	4.23 (13)	3.85 (13)
Effects of compression of gases in refrigeration	2.75 (4)	3.00 (4)	3.58 (73)	4.12 (26)	3.00 (3)	1.50 (2)	4.23 (13)	3.85 (13)

Table 30. (Continued)

Topic item	All appliances listed i	None of the appliances listed k	Washer and refrigerator n	Dryer and range p	Conventional washer q	Refrigerator and range s	Air conditioner and washer t
Effects of temperature on gases and liquids	4.20 (5)	0.00 (0)	5.00 (2)	0.00 (0)	3.00 (1)	2.00 (1)	5.00 (1)
Effects of vaporization in refrigeration	4.20 (5)	5.00 (1)	5.00 (2)	0.00 (0)	3.00 (1)	2.00 (1)	5.00 (1)
Effects of compression of gases in refrigeration	4.20 (5)	5.00 (1)	5.00 (2)	0.00 (0)	3.00 (1)	2.00 (1)	5.00 (1)

The number in parentheses indicates the number of responses.

Table 31. Importance of theory and structure of appliance mechanisms to major household appliance service technicians, as reported by employers, by appliance most frequently serviced

Topic item	Room air conditioner	Range	Clothes washer	Refrigerator and freezer	Clothes dryer	Dishwasher	Air conditioner refrigerator and freezer	Washer and dryer
	a	b	c	d	e	f	g	h
Fans and blowers	4.00 (4)	4.00 (4)	4.23 (77)	4.50 (26)	4.00 (3)	5.00 (2)	4.54 (13)	4.38 (13)
Solenoids	4.00 (4)	4.00 (4)	4.25 (79)	4.56 (25)	4.33 (3)	5.00 (2)	4.38 (13)	4.38 (13)
Heating elements	4.00 (4)	4.00 (4)	4.26 (78)	4.42 (24)	4.00 (3)	5.00 (2)	4.54 (13)	4.38 (13)
Timers	4.00 (4)	4.00 (4)	4.28 (80)	4.42 (26)	4.33 (3)	5.00 (2)	4.31 (13)	4.38 (13)
Pumps	4.00 (4)	4.00 (4)	4.22 (78)	4.44 (25)	3.00 (3)	5.00 (2)	4.46 (13)	4.38 (13)
Compressors	4.00 (4)	4.00 (4)	4.15 (79)	4.58 (26)	2.67 (3)	5.00 (2)	4.67 (12)	4.38 (13)
Motors	4.00 (4)	4.00 (4)	4.22 (77)	4.46 (26)	4.00 (3)	5.00 (2)	4.31 (13)	4.38 (13)
Gas ignition	4.00 (4)	4.00 (4)	4.10 (79)	4.04 (24)	4.67 (3)	5.00 (2)	4.46 (13)	4.38 (13)
Burners	4.00 (4)	4.00 (4)	4.12 (78)	3.91 (22)	4.67 (3)	5.00 (2)	4.46 (13)	4.38 (13)
Transmissions	3.50 (4)	3.75 (4)	4.16 (80)	4.00 (24)	3.33 (3)	5.00 (2)	4.38 (13)	4.38 (13)

Table 31. (Continued)

Topic item	All appliances listed i	None of the appliances listed k	Washer and refrigerator n	Dryer and range p	Conventional washer q	Refrigerator and range s	Air conditioner and washer t
Fans and blowers	4.67 (6)	0.00 (0)	5.00 (2)	0.00 (0)	5.00 (1)	3.00 (1)	5.00 (1)
Solenoids	4.67 (6)	5.00 (1)	5.00 (2)	4.00 (1)	5.00 (1)	3.00 (1)	4.00 (1)
Heating elements	4.67 (6)	0.00 (0)	5.00 (2)	4.00 (1)	5.00 (1)	4.00 (1)	4.00 (1)
Timers	4.67 (6)	5.00 (1)	5.00 (2)	4.00 (1)	5.00 (1)	3.00 (1)	4.00 (1)
Pumps	4.67 (6)	5.00 (1)	5.00 (2)	0.00 (0)	5.00 (1)	0.00 (0)	5.00 (1)
Compressors	4.50 (6)	5.00 (1)	5.00 (2)	4.00 (1)	3.00 (1)	0.00 (0)	5.00 (1)
Motors	4.83 (6)	5.00 (1)	5.00 (2)	4.00 (1)	5.00 (1)	3.00 (1)	5.00 (1)
Gas ignition	4.67 (6)	0.00 (0)	5.00 (2)	0.00 (0)	5.00 (1)	3.00 (1)	2.00 (1)
Burners	4.67 (6)	0.00 (0)	5.00 (2)	0.00 (0)	5.00 (1)	3.00 (1)	4.00 (1)
Transmissions	4.67 (6)	5.00 (1)	5.00 (2)	4.00 (1)	5.00 (1)	3.00 (1)	4.00 (1)

The number in parentheses indicates the number of responses.

Theory and operation of appliance controls Closely allied with the theory and structure of appliance mechanisms but yet exclusive of it is the theory and operation of appliance controls. The importance assigned to these items was also quite high. See Table 32 for a complete distribution of rating means.

Instruments Table 33, page 96, indicates the importance of instruments to the appliance service technicians as assigned by the various firm groups. The amount of variance between the individual instruments is extreme in several firm groups.

Skills or operations The importance of several skills or operations to the appliance service technician is shown in Table 34, page 98.

Table 32. Importance of theory and operation of appliance controls to major household appliance service technicians, as reported by employers, by appliance most frequently serviced

Topic item	Room air conditioner	Range	Clothes washer	Refrigerator and freezer	Clothes dryer	Dishwasher	Air conditioner refrigerator and freezer	Washer and dryer
	a	b	c	d	e	f	g	h
Timers	4.00 (4)	4.00 (4)	4.42 (79)	4.52 (25)	4.33 (3)	5.00 (2)	4.69 (13)	4.46 (13)
Thermostats	4.00 (4)	4.00 (4)	4.41 (79)	4.56 (25)	4.33 (3)	5.00 (2)	4.69 (13)	4.46 (13)
Switches	4.00 (4)	4.00 (4)	4.39 (79)	4.52 (25)	4.33 (3)	5.00 (2)	4.54 (13)	4.46 (13)
Overload protection	4.00 (4)	4.00 (4)	4.22 (79)	3.74 (30)	4.00 (3)	5.00 (2)	4.46 (13)	4.38 (13)
Temperature and its effects	4.00 (4)	4.00 (4)	4.22 (78)	4.40 (25)	4.00 (3)	5.00 (2)	4.61 (13)	4.31 (13)
Motor speed	4.00 (4)	4.00 (4)	4.15 (78)	4.48 (25)	4.00 (3)	5.00 (2)	4.23 (13)	4.38 (13)
Water level	4.00 (4)	3.75 (4)	4.43 (73)	4.00 (26)	3.67 (3)	5.00 (2)	4.31 (12)	4.38 (13)
Humidistat	4.00 (4)	4.00 (4)	4.10 (78)	4.28 (25)	3.67 (3)	5.00 (2)	4.46 (13)	4.15 (13)

Table 32. (Continued)

Topic item	All appliances listed i	None of the appliances listed k	Washer and refrigerator n	Dryer and range p	Conventional washer q	Refrigerator and range s	Air conditioner and washer t
Timers	4.67 (6)	5.00 (1)	5.00 (2)	5.00 (1)	5.00 (1)	5.00 (1)	5.00 (1)
Thermostats	4.67 (6)	5.00 (1)	5.00 (2)	5.00 (1)	5.00 (1)	5.00 (1)	5.00 (1)
Switches	4.67 (6)	5.00 (1)	5.00 (2)	5.00 (1)	5.00 (1)	5.00 (1)	5.00 (1)
Overload protection	4.67 (6)	5.00 (1)	5.00 (2)	5.00 (1)	5.00 (1)	5.00 (1)	5.00 (1)
Temperature and its effects	4.67 (6)	0.00 (0)	5.00 (2)	5.00 (1)	5.00 (1)	5.00 (1)	5.00 (1)
Motor speed	4.67 (6)	0.00 (0)	5.00 (2)	5.00 (1)	5.00 (1)	5.00 (1)	5.00 (1)
Water level	4.50 (6)	0.00 (0)	5.00 (2)	0.00 (0)	5.00 (1)	5.00 (1)	5.00 (1)
Humidistat	4.67 (6)	5.00 (1)	5.00 (2)	5.00 (1)	5.00 (1)	5.00 (1)	5.00 (1)

The number in parentheses indicates the number of responses

Table 33. Importance of instruments to major household appliance service technicians, as reported by employers, by appliance most frequently serviced

Topic item	Room air conditioner	Range	Clothes washer	Refrig erator and freezer	Clothes dryer	Dish-washer	Air conditioner refriger-ator and freezer	Washer and dryer
	a	b	c	d	e	f	g	h
Leak detectors for gas	3.50 (4)	5.00 (3)	4.21 (76)	4.20 (26)	5.00 (3)	3.50 (2)	4.67 (12)	4.67 (15)
Leak detectors for refrigerant	3.50 (4)	5.00 (3)	4.08 (76)	4.65 (26)	3.67 (3)	4.00 (2)	4.61 (13)	4.67 (15)
Ohmmeter	3.50 (4)	4.67 (3)	4.27 (73)	4.19 (26)	4.00 (3)	4.50 (2)	4.31 (13)	4.57 (14)
Dial thermometer	3.25 (4)	4.67 (3)	3.86 (74)	4.08 (25)	3.67 (3)	5.00 (2)	4.15 (13)	4.15 (13)
Oven testers	2.75 (4)	4.33 (4)	3.89 (78)	3.75 (24)	4.00 (3)	4.50 (2)	3.66 (12)	4.27 (15)
Multimeters	3.00 (4)	4.67 (3)	3.88 (75)	3.40 (25)	3.33 (3)	5.00 (2)	4.33 (12)	3.92 (12)
Time and temperature recorder	3.25 (4)	4.67 (3)	3.67 (75)	3.96 (25)	4.33 (3)	4.50 (2)	4.07 (13)	3.93 (14)
Hygrometer	2.50 (4)	3.67 (4)	2.75 (73)	3.37 (24)	2.67 (3)	3.00 (2)	3.41 (12)	2.54 (11)
Psychrometer	3.00 (4)	3.67 (4)	2.83 (71)	3.17 (23)	3.00 (3)	3.00 (2)	3.27 (11)	2.33 (12)
Psychrometer slide rule	2.50 (4)	3.33 (3)	2.63 (73)	2.87 (23)	2.33 (3)	2.50 (2)	2.91 (11)	2.00 (12)

Table 33. (Continued)

Topic item	All appliances listed i	None of the appliances listed k	Washer and refrigerator n	Dryer and range p	Conventional washer q	Refrigerator and range s	Air conditioner and washer t
Leak detectors for gas	4.00 (4)	5.00 (1)	5.00 (1)	0.00 (0)	5.00 (1)	0.00 (0)	5.00 (1)
Leak detectors for refrigerant	4.33 (6)	5.00 (1)	5.00 (1)	0.00 (0)	3.00 (1)	0.00 (0)	5.00 (1)
Ohmmeter	4.83 (6)	5.00 (1)	4.50 (2)	5.00 (1)	5.00 (1)	5.00 (1)	4.00 (1)
Dial thermometer	4.00 (5)	0.00 (0)	4.50 (2)	0.00 (0)	3.00 (1)	0.00 (0)	4.00 (1)
Oven testers	4.50 (6)	5.00 (1)	4.50 (2)	4.00 (1)	3.00 (1)	5.00 (1)	4.00 (1)
Multimeters	4.00 (4)	0.00 (0)	4.00 (2)	5.00 (1)	3.00 (1)	5.00 (1)	4.00 (1)
Time and temperature recorder	4.33 (6)	0.00 (0)	2.00 (2)	0.00 (0)	3.00 (1)	0.00 (0)	4.00 (1)
Hygrometer	2.50 (4)	0.00 (0)	3.00 (2)	0.00 (0)	3.00 (1)	0.00 (0)	4.00 (1)
Psychrometer	2.50 (4)	0.00 (0)	3.00 (2)	0.00 (0)	3.00 (1)	0.00 (0)	4.00 (1)
Psychrometer slide rule	3.00 (4)	0.00 (0)	2.00 (2)	0.00 (0)	3.00 (1)	0.00 (0)	4.00 (1)

The number in parentheses indicates the number of responses.

Table 34. Importance of operations or skills to major household appliance service technicians, as reported by employers, by appliance most frequently serviced

Operational item	Room air conditioner a	Range b	Clothes washer c	Refrigerator and freezer d	Clothes dryer e	Dishwasher f	Air conditioner refrigerator and freezer g	Washer and dryer h
Soldering	3.75 (4)	3.25 (4)	4.13 (79)	4.34 (27)	3.33 (3)	5.00 (2)	4.61 (13)	4.40 (15)
Simple house wiring	4.00 (4)	2.75 (4)	4.03 (77)	3.86 (27)	3.67 (3)	5.00 (2)	3.83 (12)	4.29 (14)
Estimating air conditioner load	4.00 (4)	3.25 (4)	3.39 (76)	3.89 (27)	4.00 (3)	4.00 (2)	4.23 (13)	4.47 (15)
Brazing	3.75 (4)	2.50 (4)	3.48 (77)	4.04 (27)	2.67 (3)	5.00 (2)	4.07 (13)	3.80 (15)
Pipe threading	3.75 (4)	2.50 (4)	3.60 (74)	3.46 (26)	4.67 (3)	5.00 (2)	3.54 (13)	3.31 (13)
Welding	3.25 (4)	2.50 (4)	3.26 (77)	3.59 (27)	3.33 (3)	4.00 (2)	3.92 (13)	3.47 (15)

Table 34. (Continued)

Operational item	All appliances listed i	None of the appliances listed k	Washer and refrigerator n	Dryer and range p	Conventional washer q	Refrigerator and range s	Air conditioner and washer t
Soldering	4.50 (6)	5.00 (1)	5.00 (1)	0.00 (0)	3.00 (1)	0.00 (0)	5.00 (1)
Simple house wiring	4.00 (6)	5.00 (1)	5.00 (1)	5.00 (1)	5.00 (1)	4.00 (1)	5.00 (1)
Estimating air conditioner load	4.00 (6)	5.00 (1)	3.50 (2)	0.00 (0)	3.00 (1)	4.00 (1)	4.00 (1)
Brazing	4.00 (6)	0.00 (0)	4.50 (2)	0.00 (0)	3.00 (1)	0.00 (0)	4.00 (1)
Pipe threading	3.67 (6)	5.00 (1)	0.00 (0)	3.00 (1)	0.00 (0)	5.00 (1)	3.00 (1)
Welding	3.33 (6)	5.00 (1)	4.50 (2)	0.00 (0)	3.00 (1)	0.00 (0)	4.00 (1)

The number in parentheses indicates the number of responses.

DISCUSSION

This study represents an attempt to provide a basis for making educational decisions in the realm of major household appliance service training. It was limited to specific appliances with the hope that doing so would provide more meaningful data. Because the study involved only specified appliances, these data cannot be generalized to include all appliance service personnel or service firms.

Even though the study did not survey firms in communities of less than 2,500 population, it was felt that the data would be meaningful in describing the needs of the state for additional appliance service technicians. The basis for this statement was the assumption that firms in communities smaller than 2,500 would not employ a significant number of technicians, other than those who are self-employed. While no information was gathered to substantiate this assumption, questionnaires returned from one-man, owner-operator type of firms in the smaller communities included in the study lent support to it. The majority of these firms replied that they felt they had nothing to offer by completing the questionnaire. They indicated that they had not employed additional technicians and did not intend to do so in the future.

Conversations with employers of appliance service technicians prior to the survey led the author to believe that a critical shortage of appliance service technicians existed in Iowa. The data collected by this survey do not support this opinion.

It is true that there is a shortage of appliance service technicians as indicated by the 70 vacancies identified by 181 firms. In order to evaluate the severity of this shortage, a vacancy-firm ratio can be computed. The data from the responding firms indicate a vacancy-firm ratio of 31 percent. A similar ratio computed from the data reported in Appliance Service Labor Market Survey (1) was 101 percent. A comparison of these figures would indicate that either Iowa's shortage is not as critical as the shortage throughout the nation, or the supply of technicians in Iowa has been increasing substantially. The author supports the former theory. While it is true that the national survey was conducted in 1965 and this survey was conducted in 1968, it would appear that three years is a very short time to reduce the number of vacancies to one-third their original number.

The increase in employment levels from 1967 to 1968 was reported to be 29. This indicates that the need is not created solely by expansion. This figure represents a growth of around eight percent.

The author believes that the number of vacancies as well as their location is related to wages. The belief was founded upon comments made by respondents on the questionnaire. These comments made reference to the fact that factory jobs and governmental positions paid better wages and required fewer working hours. Comments were also made concerning governmental programs such as unemployment compensation and their effect on the desire of the individual to work. While such comments may or may not have been made on substantial

evidence, they do indicate that the monetary incentive is not excessively great.

The data presented in the findings indicate that the wages paid to appliance service technicians are probably equal to or above the national average as reported in the national survey (1). However, these wages do not compare favorably with the 1965 wages reported to have been paid to other types of service personnel.

In the previous chapter, it was noted that no discernible relationship could be identified between wages received by major household appliance service technicians and the population of the merged area in which they worked. While it might be possible to generalize and say that in most of the highly populated areas the appliance service technicians were paid higher wages than those working in the less heavily populated merged areas, there were too many exceptions to make such a statement justifiable.

It would not be unreasonable to assume that a merged area is geographically too large for such a comparison. If the size of the communities in which the firms were located were compared with the wages paid, some general pattern might be established. To do so in this study would have been relatively meaningless because of the small number of firms responding from many of the outlying communities. It is doubtful that appliance service technicians are paid similar wages in all communities of comparable size, but such a comparison would be more meaningful than a comparison between merged areas.

Uncertainty of the future was exemplified by the reluctance of the responding firms to project future expansion and employment levels. If the year 1967-1968 was to be considered characteristic of the expansion of the appliance service industry, the reported levels of anticipated employment are low. Assuming that the expansion of 1967-1968 was characteristic, an employment level of 870 appliance service technicians could be expected by 1971 for the firms that responded to the questionnaire. This is an increase of 110 over the estimated 1969 employment level. Adding to this figure the 85 vacancies unfilled at the time of the response, gives a total of 195 appliance service technicians needed over a four-year period.

If the state were to train enough technicians to satisfy this need, 49 major household appliance service technicians would have to be trained each year. However, if the projected employment levels given by the employers were used, this figure reduces to 46. Neither of these figures includes replacement needs.

It is not necessary to assume that this many technicians must be trained in training programs. The evidence presented in the previous chapter points out the fact that vocational education has not been the major source of training for appliance service technicians in the past. From the available evidence, it would appear that on-the-job training has played the major role for this occupation.

It is the belief of this author that employers do not fully accept the person trained in a vocational school as being competent. Comments written in the margins of the questionnaires reflect the attitude that experience is vital. Not only is experience vital to the success of the appliance service technician, in some cases it was presented as being a prerequisite to employment.

In general, there appears to be a shortage of appliance service technicians in the state of Iowa. However, the evidence does not indicate the need for a crash program to train these technicians. The evidence does indicate a probable need for part-time up-grading programs. One or two full-time programs, strategically located within the state should provide the needed numbers of major household appliance service technicians.

The data collected for use in this study indicate that any training programs established for the purpose of training major household appliance service technicians should be set up to train a person capable of servicing a variety of machines. Emphasis should be placed on the servicing of such machines as washers and dryers. Consideration might be given to the training of specialists in the field of refrigeration.

It should be noted that the data presented in this study were quantitative, and in no way reflect the quality of workmanship of individuals, firms, or the industry. Future studies in this area could possibly provide insight into proficiency and quality servicing by studying qualitative data.

SUMMARY

The objectives of this study were:

1. To determine the number of Iowa firms employing persons for the purpose of servicing and repairing major household appliances, in communities larger than 2,500 population.
2. To determine the additional needs of the identified firms employing service and repair specialists for major household appliances, both now and for three years in the future.
3. To determine the knowledge and skills which firms employing service and repair specialists for major household appliances desire their specialists to possess.
4. To determine if there is a need for part-time educational programs such as night school, for upgrading employed appliance service technicians.

The study was limited to the state of Iowa. It was also limited to the specific appliances of room air conditioners, clothes washer, clothes dryers, refrigerators and freezers, ranges, and dishwashers.

In order to attain these objectives, questionnaires were sent to the employers of major household appliance service technicians. Useable questionnaires were returned from 181 firms which could be classified into the 16 merged areas of the state. Three questionnaires were returned from firms whose operations crossed merged area boundaries. Two of these firms were

utility companies and the third was a distributor of appliances and appliance repair parts. The information included in the questionnaire from the distributor was compiled from 75 appliance service firms within the company's service organization.

The first objective was not fully satisfied, in that it was impractical to determine if all of the appliance service firms within the specified communities had been identified. In addition, questionnaires were not returned by all of the identified firms. This also affected the success met in fulfilling the second objective by limiting the data.

The responding firms were classified according to size, as determined by the number of appliance service technicians they employed. It was determined that over 92 percent of the responding firms employed four or less appliance service technicians.

Service is offered for all of the appliances enumerated by the study in each of the merged areas, except for Area II in which no service was reported for "gas room air conditioners" or "gas refrigerators and freezers". In general, more firms provide service for electric appliances than for gas appliances.

"Electric clothes washer" and "electric clothes dryer" were the appliances serviced by more firms than any other appliance.

"Refrigerator and freezer" was the category of appliances that was identified as being the most difficult to hire technicians to repair. "Clothes

washer" was the category of appliances given the distinction of being the most often serviced. "Dishwasher" was the appliance serviced least often.

Refrigeration was the field in which the most specialists were desired.

The firms split about equally in answering "yes" or "no" when asked if they would hire a specialist on one class of appliances, if he were available.

The majority of firms indicated that they had experienced difficulty in hiring qualified appliance service technicians. The primary reason identified as a cause for this difficulty was that the applicants for the position lacked the necessary qualifications. A lack of applicants for the position was also indicated as a reason by a substantial number of firms.

On June 1, 1967, the reporting firms indicated an employment level of appliance service technicians of 588. The employment level one year later was reported to be 719. Projected employment levels of appliance service technicians ranged from 760 in 1969 to 857 in 1971. The latter figure represents the responses from 18 fewer firms than does the former. As the projections reached further into the future, the firms became less willing to project employment levels.

Position openings were available for 85 appliance service technicians at the time the questionnaires were returned.

Replacements in the realm of appliance service technicians totaled 69 for the year June 1, 1967, to June 1, 1968. A total of 128 replacements were anticipated for the years 1969 through 1971. Again, the firms responded less freely as the projections were made further into the future.

The age of Iowa's appliance service technicians is relatively young, as determined by the data supplied from the responding firms. The median age of the appliance service technicians was computed to be 36.2 years. The number of

technicians under 40 years old was 459. Those over 60 numbered 27, four of which were over 65. There did not appear to be an age-firm size relationship.

The wages earned by major household appliance servicemen were reported as being greater than the national average wage in 1965. However, the wages received did not compare favorably with the wages paid to other types of service personnel in 1965.

The median wage paid to major household appliance service technicians as reported by their employers was $3.16 per hour. In general, as the firm size increased, the wages increased. The firms employing one or two appliance servicemen reported a median wage of $2.89 per hour, while the firms employing over ten technicians reported a median of $3.52 per hour. There was an indication by some firms that fringe benefits, profit sharing and commissions were not included in this figure or that they were estimated.

Most of Iowa's appliance service technicians have attended manufacturer's training courses. Less than a fifth of them had ever attended either high school vocational programs, vocational schools or trade schools. Nearly a fourth of the technicians had experience as their only source of occupational education.

Part-time educational programs, such as night school, in the occupational field were thought to be potentially beneficial to 56 percent of the appliance service technicians. Fifty-nine percent would be encouraged to attend such training programs by their employers, but only 35 percent were believed to be individuals who would actually attend.

In the realm of the educational needs of appliance service technicians, various items of curricular material were rated by the employers on a one to five scale. The scale was: (1) very little importance, (2) background knowledge only, (3) desirable, (4) highly desirable, and (5) essential.

In the category of mathematics, basic mathematics was thought to be "desirable" while the more advanced mathematics rated as "background knowledge only".

The ability to write grammatically correct reports and letters was given a mean rating of 3.40. Good spelling skills were rated 3.38. Knowledge of sentence structure was rated 2.93. Skill in the use of words was assigned a rating of 1.85. Penmanship, speech and vocabulary, and clean vocabulary were suggested by the employers as possible items for inclusion in a course of study.

All items of business practices, except "knowledge of accounting procedures" rated above 2.50. The items of business practices rating above 4.00 or "highly desirable" were: ability to talk with customer, show interest in customer, ability to estimate repair costs prior to work, and ability to handle service policies and warranties. These items were given in order of descending importance.

Items of electrical information generally rated from desirable to highly desirable. The two items regarded as the most important were "electrical safety" and "reading wiring diagrams". The least important item, and the only one rating less than 3.00 was "A-C polyphase power".

Chemistry was rated less important than the electrical information. "Effects of detergents" was the item of chemistry regarded as the most important. It received a rating of 3.25.

Physics items all rated above 3.00. No great differentiation was noted between items.

Thermodynamics items were rated from 3.70 to 3.77. These items were basically related to refrigeration.

All items of theory and structure of appliance mechanisms were regarded as highly desirable. There was little variation in the importance assigned to the individual items.

The theory and operation of appliance controls rated above highly desirable on all items. Again very little variation was apparent between individual items.

In the category of instruments, leak detectors and the ohmmeter were regarded as the most important. Each was rated at 4.25. The instruments regarded as least important were the hygrometer, psychrometer and the psychrometric slide rule. These three all rated below 3.00.

Of the operations and skills listed in the questionnaire, soldering was thought to be the most important with a rating of 4.05. Welding was ranked lowest in importance at 3.42. However, this rating of 3.42 exceeds the rating of desirable.

In addition to the foregoing importance rating assigned to the curricular items by the total number of firms, each item rating was determined according to certain classifications of firms. These firm classifications were determined by the responses of the individual firms to the question, "Which appliance do you service most often?".

Variations in the value of the importance ratings assigned to each item were noted between the various categories of firms. However, the greatest variations were exhibited by those groups in which few firms were classified.

Generalizations

The generalizations drawn by the author from the data available are fourfold.

1. There is a shortage of appliance service technicians in the state of Iowa. However, the shortage is not critical enough to warrant a crash program to train major household appliance service technicians.
2. There is need in the state of Iowa for one or two full-time training programs for appliance service technicians.
3. There is a need for part-time, up-dating programs in the area of appliance service. These programs should be so located within the state as to make them available to the largest number of appliance service technicians.

4. If a training program is to be established to prepare technicians more specifically trained on a particular appliance group, this appliance group should be "refrigeration".

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APPENDIX A: QUESTIONNAIRE

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY
Ames, Iowa 50010

DEPARTMENT OF EDUCATION

Dear Sir:

An important research study is presently being conducted in the state of Iowa to determine the need for educational programs designed to train qualified appliance service technicians. Your firm has been selected as one of those most likely to provide valuable information in this matter.

The need for this study has been brought about by the findings of the U. S. Department of Labor and the Appliance Service News. The findings of these two organizations point up a national need for appliance service technicians. It is predicted that by 1975 some 90,000 jobs in appliance servicing will have to be filled.

This study hopes to shed light on the needs for appliance service technicians in the state of Iowa. It is limited to the following appliances: room air conditioners, refrigerators, freezers, ranges, ovens, dryers, washers, and dishwashers.

Assuming the needs of Iowa are similar to those indicated for the nation, the study hopes to also provide necessary information for setting up adequate educational programs within the Area School and Community College framework.

Your cooperation is requested by completing and returning the attached questionnaire. All information will be held in strictest confidence and used only for the purpose of compilation and analysis in relation to the needs of the state.

If you do not service any of the appliances mentioned, please state this fact on the front of the questionnaire and return it blank.

Your time, effort and cooperation will be greatly appreciated.

All participating firms will receive a summary upon completion of the study.

Sincerely yours,

Lowell L. Carver
Lowell L. Carver, Chairman
Industrial Education
Iowa State University

Robert L. Stephens
Robert L. Stephens
Industrial Education
Iowa State University

The items on the following pages refer to Major Household Appliance Service Technicians and points of interest relative to the occupation. Please respond to all items as they apply to your firm. Remember this study is concerned with only room air conditioners, refrigerators, freezers, ranges, ovens, dryers, washers, and dishwashers.

Please place in the blank the proper number that best describes the conditions as they presently exist in your firm.

I. Number of appliance service technicians

_____ A. employed June 1, 1967.
_____ B. employed June 1, 1968.
C. expected to be employed by
_____ 1. June, 1969
_____ 2. June, 1970
_____ 3. June, 1971
_____ D. replaced since June, 1967.
E. expected to be replaced from
_____ 1. June, 1968, to June, 1969
_____ 2. June, 1969, to June, 1970
_____ 3. June, 1970, to June, 1971
_____ F. needed for unfilled vacancies now.
G. How many service technicians have received training through
_____ 1. high school vocational courses?
_____ 2. vocational or trade schools?
_____ 3. manufacturer's training courses?
_____ 4. experience only?
_____ 5. other? Please specify _____
_____ H. How many service technicians would benefit from night classes or other in-service training, if provided by the Area Schools?
_____ I. How many would you encourage to attend in-service training programs if provided?
_____ J. How many do you think would attend in-service training programs if provided?
K. How many service technicians with ages from
_____ 1. 20 to 29?
_____ 2. 30 to 39?
_____ 3. 40 to 49?
_____ 4. 50 to 59?
_____ 5. 60 to 65?
_____ 6. over 65?
L. How many service technicians with wages from
_____ 1. $1.00 to $1.49?
_____ 2. 1.50 to 1.99?
_____ 3. 2.00 to 2.49?
_____ 4. 2.50 to 2.99?
_____ 5. 3.00 to 3.49?
_____ 6. $3.50 to $3.99?
_____ 7. 4.00 to 4.49?
_____ 8. 4.50 to 4.99?
_____ 9. 5.00 or over?

II. Do you find it difficult to hire qualified appliance service technicians? ____Yes _____No

III. If yes, why?
_____ lack of applicants.
_____ applicants lack necessary qualifications.
_____ other. (Please specify) _____
_____

IV. Appliances
A. Check the *gas appliances* that you service.
_____ Room Air Conditioners _____ Refrigerator - Freezer
_____ Ranges or Ovens _____ Dryers
B. Check the electric appliances that you service.
_____ Room Air Conditioners _____ Refrigerator - Freezer
_____ Ranges or Ovens _____ Dryer
_____ Washer _____ Dishwasher
C. For which appliance is it the most difficult to get qualified technicians? _____
D. Which appliance do you most often service? _____
E. Which appliance do you least often service? _____
F. If you employ technicians to specialize on one particular appliance, please state which appliance. _____
G. If it were possible for you to hire a specialist, on which machine would you wish him to work? _____
H. Would you hire a specialist if they were available? _____Yes _____No

Respond to each item below according to the value of the item to appliance service technicians, and students studying to become appliance service technicians. The blank spaces are provided to give you an opportunity to add any items you feel are missing but essential.

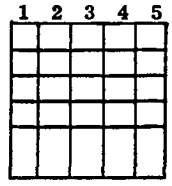
RATING SCALE. (check the most appropriate rating)
1. Very little importance.
2. Background knowledge only.
3. Desirable.
4. Highly desirable.
5. Essential.

1	2	3	4	5	
					A
					B
					C

V. Mathematics
A. Basic mathematics including common fractions, decimal fractions, powers and roots of numbers, shop computations involving measurement and conversion factors, etc.
B. More advanced mathematics including solving algebraic problems with one and two unknowns, solving simultaneous equations, trigonometric relationships, etc.
C. _____

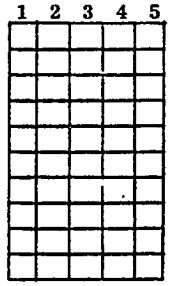
RATING SCALE

1. Very little importance
2. Background knowledge only
3. Desirable
4. Highly desirable
5. Essential



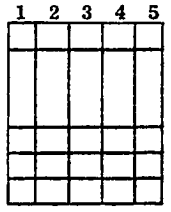
VI. English

A. Good spelling skills.
B. Skill in use of words.
C. Knowledge of sentence structure.
D. Ability to write grammatically correct reports and letters.
E. _____



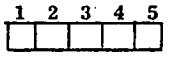
VII. Business Practices

A. Skilled in the use of public relations.
B. Skilled in the art of salesmanship.
C. Knowledge of accounting procedures.
D. Knowledge of marketing procedures.
E. Ability to handle warranties and service policies.
F. Have good physical appearance.
G. Show interest in customer.
H. Ability to talk with customer.
I. Ability to estimate repair costs prior to work.
J. _____

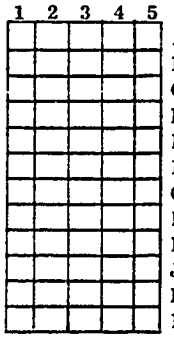


VIII. General Electrical Information

A. Basic electricity including electron theory, sources and production of electricity, electrical and electronic symbols, ohm's law, magnetism, and electromagnetism.
B. Reading wiring diagrams.
C. Electrical safety.
D. Fundamental solid state theory.
E. _____



IX. Basic D-C Current

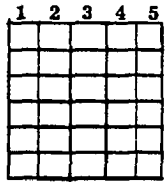


X. A-C Current

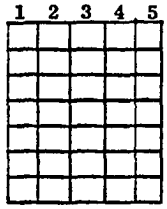
A. Inductance and inductive reactance.
B. Capacitance and capacitive reactance.
C. Series circuits.
D. Parallel circuits.
E. A-C power and power factor.
F. A-C single phase power.
G. A-C polyphase power.
H. Wye and Delta systems.
I. Single phase, 3-wire installations.
J. Three phase, 3-wire installations.
K. Electromagnetism.
L. _____

RATING SCALE

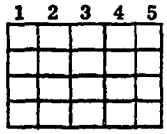
1. Very little importance
2. Background knowledge only
3. Desirable
4. Highly desirable
5. Essential



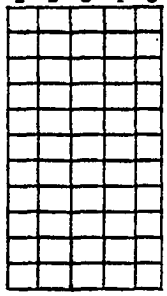
XI. Chemistry
- A. Basic reactions.
- B. Effects of detergents, bleaches, etc.
- C. Water chemistry.
- D. Corrosion.
- E. Chemistry of refrigerants.
- F. _____



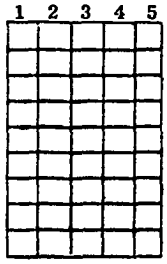
XII. Physics
- A. Mechanical advantage.
- B. Sensible heat.
- C. Latent heat.
- D. Heat of compression.
- E. Heat of vaporization.
- F. Air-gas mixture in combustion.
- G. _____



XIII. Thermodynamics
- A. Effects of compression of gases in refrigeration.
- B. Effects of vaporization in refrigeration.
- C. Effects of temperature on gases and liquids.
- D. _____



XIV. Theory and structure of appliance mechanisms.
- A. Motors.
- B. Transmissions.
- C. Timers.
- D. Solenoids.
- E. Heating elements.
- F. Gas ignition.
- G. Burners.
- H. Fans and blowers.
- I. Pumps.
- J. Compressors.
- K. _____



XV. Theory and operation of appliance controls.
- A. Timers.
- B. Motor speed.
- C. Switches.
- D. Thermostats.
- E. Humidistat.
- F. Overload protection.
- G. Temperature and its effect.
- H. Water level.
- I. _____

RATING SCALE

1. Very little importance
2. Background knowledge only
3. Desirable
4. Highly desirable
5. Essential

1	2	3	4	5	
					A
					B
					C
					D
					E
					F
					G
					H
					I
					J
					K

XVI. Instruments

A. Hygrometer.
B. Psychrometer.
C. Psychrometric slide rule.
D. Oven testers.
E. Ohmmeter.
F. Multimeters.
G. Dial thermometer.
H. Time and temperature recorder.
I. Leak detectors for refrigerant.
J. Leak detectors for gas.
K. _____

1	2	3	4	5	
					A
					B
					C
					D
					E
					F
					G

XVII. Operations or skills

A. Brazing.
B. Soldering.
C. Welding.
D. Estimating air conditioner load.
E. Pipe threading.
F. Simple house wiring.
G. _____

Name of your firm. _____

Address. _____

Position of person answering questionnaire. _____

APPENDIX B: FOLLOW-UP CORRESPONDENCE

Dear Sir:

Recently you received a questionnaire concerning the needs for appliance service technicians in the state of Iowa. To this date, I have not received your completed questionnaire. I wish to remind you that this study is extremely important in determining the programs to be set up in the Community Colleges of the state.

If the questionnaire has been laid aside or gotten under a pile of papers, please dig it out, complete it, and mail it to me in the self addressed envelope. Your response is extremely important because only you can supply the needed information.

If you have already returned the questionnaire, please ignore this card. Thank you for your kind cooperation.

Yours truly,

Robert L. Stephens, Industrial Education
Iowa State University, Ames, Iowa 50010

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY
Ames, Iowa 50010

DEPARTMENT OF EDUCATION

Dear Sirs:

About six weeks ago you should have received a copy of the enclosed questionnaire. I am sending you another on the chance that it has been misplaced, or lost in the mail, as I have no record of having received yours.

I wish to emphasize the importance of this study to your industry. With the information obtained from you and 487 firms like yours, we will be able to determine if courses designed to prepare repairmen should be set up in the Area schools and Community Colleges. Your response is vital to the success of this study for without it we cannot get a complete picture for the state. If courses are set up in the Area schools, it will mean a larger supply of trained men available for your firm and the state in general.

Please sit down, complete the questionnaire, and return it to me before August 15, 1968. If by chance you have already returned your questionnaire or you feel that this study does not apply to you, please check the appropriate box below and return this sheet in the enclosed envelope.

Your cooperation is very important and will be greatly appreciated.

Thank you for your time and effort.

Sincerely,

Robert L. Stephens

Robert L. Stephens
Industrial Education
Iowa State University

☐ I have already returned my questionnaire.

☐ I feel that this study does not apply to my firm because _____

_____